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Engineering News-Record

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June 14, 1928

Sand Control Works, Fort Laramie Canal

Second of Two Articles on Modern Cements

Building an Airport at Portland, Oregon

Reconditioning Old Sewers at St. Louis

Skimming Weir, Fort Laramie Irrigation Canal

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Construction Efficiency

REPORTS from other industries show a consistent tendency toward increased efficiency in production. What can be said in this respect for the construction industry? We can point with pride to the speed in construction of various jobs throughout the country. Owners, with a keen eye on interest charges, are demanding early completion of every project. Contractors are meeting these demands, completing work within time limits not thought possible a decade ago. What has brought about this change within the industry? Aside from attaining speed in construction, what is being done toward more efficient production? Industries outside our field depend upon mass production, organization and organized research to render their work more efficient. Of these three methods, organization is the main resource at present available to the construction field. Undoubtedly we are more efficient than in the past, but what tangible evidence have we for comparison? Increasing competition among contractors calls for increasing efficiency, and *apparently* the industry is growing more efficient in production. But can it show definitely that it is keeping pace with other industries in this respect? Construction has the duty of answering these questions.

Muscle Shoals and the South

THE ultimate disposition of the power and nitrate plants at Muscle Shoals, a problem which has been with us since war days, remains as much unknown as ever. The President, by a "pocket veto," killed the joint resolution of the two houses of Congress which would have adjusted the question for the present. The resolution set up a corporation to operate the power and nitrate plants, authorized the Secretary of War to install additional steam and hydro-electric units at Muscle Shoals and to build a dam and power plant on the Clinch River at Cove Creek, and provided a fund of $10,000,000 for the purposes of the act, including $2,000,000 for the start of construction at Cove Creek. The resolution deserved more positive disposition than a pocket veto. It would have been better had the President pointed out what Congress seems to have failed to realize—namely, that while it has been dickering over Muscle Shoals the only one of its two nitrate plants which ever would work has become obsolete. Large blocks of power no longer are essential to the fixation of nitrogen. Under such circumstances Muscle Shoals presents no complicated problem. All the power it can produce under present conditions is being used in the neighboring states. Before the Cove Creek dam and power house can be built and additional units installed at Muscle Shoals to use the increased flow that Cove Creek storage will provide the increasing demand of the Southeastern states will far exceed the combined output of the two plants. For Congress to hold to a belief that the government should foster the production of nitrate is no crime, but for it to continue to let that belief hold up the normal development of one of the great resources of the Southeastern states is unfortunate indeed. Muscle Shoals as a power proposition should be divorced from the defunct Muscle Shoals nitrate plants. The South needs all the power it can get.

Engineers All

TO THE thousands of young graduates from our universities and technical schools who are now entering the profession, *Engineering News-Record* extends a hearty welcome. The problems of the classroom, which they have mastered, will now give way to those of professional life, more difficult, but promising fuller reward. Among the new conditions the graduate must face is the attitude which he will find among established engineers toward himself and his mates. From time immemorial the youth entering among strangers has been the target of ready criticism, and so the young graduate need not be surprised if he meets with a questioning attitude on his first job. The question will be directed less to his technical knowledge than to those intangible qualities so necessary to the practicing engineer: integrity, sincerity, open mindedness and common sense. However individual graduates may differ in these characteristics, in one point all of them will prove themselves, we know—namely, in earnest determination to succeed. Long and tedious hours over the drawing board and in the laboratory have tested out this sincerity of purpose, and the trifler and idler long ago dropped out. Those who survived did so by virtue of determination, ambition and perseverance. They come into the profession, then, as raw material of infinite possibilities which it is the responsibility of the older men to develop.

Economic Sense

FOR some years there have been divergent views on engineering education, among which two are specially interesting at present. One, which we may call the engineering science view, is in favor of teaching primarily such things as mechanics, together with a few "applied" subjects to serve as illustrations and as guides to the practical utilization of the sciences. The other, which for lack of a better name may be called the finishing-school view, is held by those who would use the engineering course as a medium for producing not only engineer apprentices but also well-rounded men and citizens. Proposals to teach economics and business in the engineering course lead to disagreement somewhat along this line. Both aspects of the subject were excellently discussed by W. E. Wickenden recently in an address at Pennsylvania State College, and the part of his address which we reproduce this week is eminently worth reading. Taking the liberty of diverging a bit from the course of thought which he followed, we would suggest that colleges will

probably remain, as they always have been, places for teaching definite knowledge of the sciences and arts, and will never become institutions for instilling sense into the students. Certain things are better learned spontaneously than imparted by classroom instruction, and among these is sense. Economic sense is merely part of the whole, and the student who lacks it or fails to acquire it by living will not be much benefited by reams of social economics or sheaves of business calculations. The boy who learned in Poor Richard's time that he paid too much for the whistle could never have learned that same truth in the class of an economics professor. Nor could Henry Ford have learned that it was worth while to borrow money to build an automobile.

Controlling Sand Deposits

SILT and sand deposits always have been difficult problems for the operators of canals and reservoirs. So far, few satisfactory methods of handling either have been found. In our issue of May 10, comment was made upon the method proposed for disposing of gravel débris which is expected to accumulate behind a dam for the Far West Irrigation District in California. (*Engineering News-Record,* May 17, 1928, p. 778.) It was pointed out there that one disadvantage of such a plan is the loss of valuable flood waters which the sluicing operation involved. In this issue is given a summary of results which have been obtained on the Fort Laramie Canal on the North Platte irrigation project, in which the normal flow of the canal is used over periods of short duration to flush sand from a specially designed settling basin built in the canal below the intake. Earlier methods tried for disposing of the sand at the intake proved unsuccessful. From results obtained in the comparatively short time during which the present method has been in operation it appears that a satisfactory and economical method has been found, at least for conditions similar to those encountered in the Fort Laramie Canal.

A Century of Service

ONE HUNDRED years ago, on June 3, a royal charter was granted to the Institution of Civil Engineers, London, and thereby a young organization which was destined to become one of the great factors in the advancement of engineering in the whole world was started upon its career. Ten years previous to that date a group of enthusiastic young men had formed the society, but civil engineering lacked individuality, and a royal charter could not at once be asked for. In fact, so indefinite was the general knowledge of what constituted civil engineering that it was necessary for the council of the Institution to ask Thomas Tredgold, an honorary member, to draw up a definition, the result being his famous statement that it is "the art of directing the great sources of power in Nature for the use and convenience of man." A century has passed, and now—in the week just past—the Institution formally celebrated its notable anniversary.

On this occasion we feel that we may be permitted to offer the congratulations of American civil engineers. It would be to ignore the most important aspect of the celebration, however, did we not also voice appreciation of the great service which the Institution has rendered throughout its hundred years of life, in fostering and stimulating the development of that great profession which we feel proud to call our own.

For its achievements, for the merited world-wide influence it has acquired, for the strength and power which it has inculcated in civil engineers everywhere—not the least in the United States—we feel warmly grateful. And may the Institution long continue to serve engineers and encourage them to be, in the language of one of its founders, the mediators between the philosopher and the working mechanic.

Fuller Industrial Co-operation

DURING the recent growth of industrial group co-operation through the industrial association, that remarkable modern analogue of the old guild, many great things have been accomplished. Greater things remain to be done, if group co-operation is to fulfill its present promise of usefulness. The industrial association movement is backward in many of its manifestations. Its influence on the efficiency of production is often disappointingly small, or quite wanting, and many glaring misadjustments of the industrial machine remain a challenge to the ability of co-operation to deal with them.

If reasons for lack of success and co-operation be searched for, two matters in particular attract notice: First, that in many cases the movement fails to gain full support within its own circles; and second, that the real objectives of industrial co-operation are often misunderstood. This second difficulty, while it accounts for much misdirected effort and occasional harmful results, is nevertheless secondary, and its consideration may be left for future discussion. But the failure of the association plan to receive the full support of a particular industry is a vital disease, since it involves the very existence of group co-operation. If industrial co-operation serves any useful purpose, that purpose is important enough to warrant thoroughgoing union of all the interests in the group, in order to achieve it; and unless substantially complete union is attained, effective results of broad scope are rarely possible.

In certain industries a few strong elements take the attitude that the smaller companies in the group may well co-operate, but for their own part they do not need to join. Whether their attitude is due to carrying the commercial competitive spirit over into the quite different co-operative field, or whether they feel that co-operation might prove irksome or troublesome, in either event the outcome is unfortunate and destructive. The argument on the other side is plain: If the industry as such has difficulties which bear on all its members, and which in the common interest should be solved, these difficulties are as serious to the large corporation as to the small one, and usually more in ratio of its size; and while their direct effect may be less obvious to the chief executives of a highly departmentalized organization, they are none the less present. The smaller members of the group cannot by themselves handle to good effect these general questions, or at best they can bring about only a makeshift adjustment.

Some industrial associations are notably successful, while others are not. If the observer asks why one such body accomplishes valuable results and others merely mark time, he will find the key in the completeness of co-operation in the industry concerned. At least three important industrial associations in the civil engineering field contrast sharply, by their relative ineffectiveness, with most of the others, and in each instance it is a fact that the industry is not united in its co-operation.

Important elements, and in two instances almost a majority representation of the industry, remain outside. Have these industries no important problems adapted to co-operative work? Yes—all three have most serious problems and face an increasingly difficult future. There is ready reason for believing that complete co-operation would bring about real improvement; yet the industry remains divided. In short, the principal obstacle to the effectiveness of industrial group co-operation appears to lie within the industry itself—whether or not it has organized for full co-operation.

From the very nature of co-operation and its relation to the conflicting interests of a competitive group, it is almost axiomatic that unless an entire industrial group joins in the co-operative attack on problems of common concern, the system is bound to be a failure. In these days of inter-industry competition, of necessary discussion and reform of trade practices, of joint research, of uniform cost accounting, of traffic difficulties, basing points and what not, the community of interest within any one field of production is too obvious to be ignored. The problems of an industry will not solve themselves; left alone, they are apt to grow and impair the health of the industry ever more seriously. They must be solved by direct study of causes and conditions in relation to the productive efficiency of the industry, and this in turn is possible only through full co-operation.

To summarize the situation briefly, the industry must hang together, or it will hang separately, as was said long ago in another connection.

High-Strength Cements

LAST week in this column we expressed the belief that the making and using of special hydraulic cements will continue and will grow. The subject of high-early-strength cements discussed by P. H. Bates this week in the concluding half of his article is of particular importance in connection with this prediction. Present-day construction puts forward constantly higher service demands, and this fact, coupled with the advance in cement-making skill, places the new type of cement in a position of great prominence.

How greatly these cements are needed, and whether they may be nothing more than seemingly new types of old cements, are questions yet to be answered. The quick-hardening cements are as little known as was portland cement thirty years ago, and this means that we have still to learn nearly everything about them. They are held to give the 7- to 28-day strength of standard portland in about 24 hours. But whether or not this is true under all circumstances is by no means certain. The fact in the field is that the characteristics of each individual job, each individual contractor, each individual contract and its surrounding circumstances and personnel will in large measure determine the result obtained from any cement, whether standard or quick-hardening; and only these results on a collected number of jobs will determine the commercial fate of the special cements, since in the end their actual ability alone will count.

During the last three or four years the cement industry of the United States has undergone the unpleasant experience of finding itself lagging behind as to growth of use. A special cement offering the near-miracle of high early strength and giving promise of cheaper ways to do work seemed one way out of this dilemma. But it is easy to overlook the fact that new cements are not a specific against the common abuses which bring about unsatisfactory concrete. The virtue of quick hardening will not accomplish the miracle of making silk purses out of sows' ears. It will not make it possible to produce good concrete by bad methods.

The fact appears to be that study of how to make good concrete came along rather late in the period of single-standard portland, too late to put its impress on the majority of structures now existing, and too early to build up a universal conviction that standard portland *plus* skilled construction can meet all needs of the concrete user. On this latter point, however, there is a fruitful opportunity for more educational work. Knowledge of what can be accomplished by more skillful use of normal cement remains inadequate. The newer study of concrete is often utilized only for obtaining pennywise economies or for achieving mixtures which are mathematically satisfying but practically disappointing; it is less often applied to the task of producing the soundest, strongest, quickest-hardening concrete that can be made. It ought to be extended to the point of determining under what conditions a normal concrete is equal to special-cement concrete, possibly even with better all-around results. For the present, the necessary information on these matters is lacking.

The entire concrete art is still in large measure chaotic. It is hopeful to know that even the old type portland cements can perform miracles, and low-cost miracles at that, if intelligently used. Nor does the achieving of these results in any degree depend on the attainment of any high early strength. Yet high early strength does most evidently answer strongly felt needs. The new cements will succeed according to the excellence of their performance in meeting these needs.

One point, a question of immediate importance and urgency, concerns makers and users alike: the standardization, or rather *classification*, of cement. The present situation is trouble-breeding for all of the parties involved. The engineer stands, as it were, before a patent-medicine chest where his only guide is brand labels and makers' claims; nor does he know even that name and claim will mean the same thing in December as they did in May. The cement maker, on the other hand, is in no less unfortunate position. He lacks any definite statement of what the engineer requires—such a statement, for instance, as would be given by a series of performance specifications—and, accordingly, he will produce the product that promises to have greatest sales appeal. If the taste of the moment appears to run toward high early strength, without limit or qualification, he will push his efforts steadily in that direction, regardless of other properties.

Standardization would clearly be premature at this time. But classification is another matter. Probably high-strength cements can be, and by all means they should be, grouped according to major characteristics, in a grouping that has equal regard to manufacturing possibilities and service requirements. At the moment the condition is unsettled, and the problem of reform is not being attacked with any vigor. A recent cement committee meeting that devoted two days to discussion of specifications, without mention of special cements, reflects a natural but yet untimely reluctance to take up the problem. But if the concrete industry is to remain the constructive element that it long has been in the development of civil engineering, there should be early action.

Sand-Control Works at Fort Laramie Canal Intake

Sand Problems at Whalen Dam, North Platte Irrigation Project, Solved by the Construction of Settling Basin, Skimming Weir and Sluiceway Below the Intake

By Ivan E. Houk
Research Engineer, Office of Chief Engineer, Bureau of Reclamation, Denver, Colo.

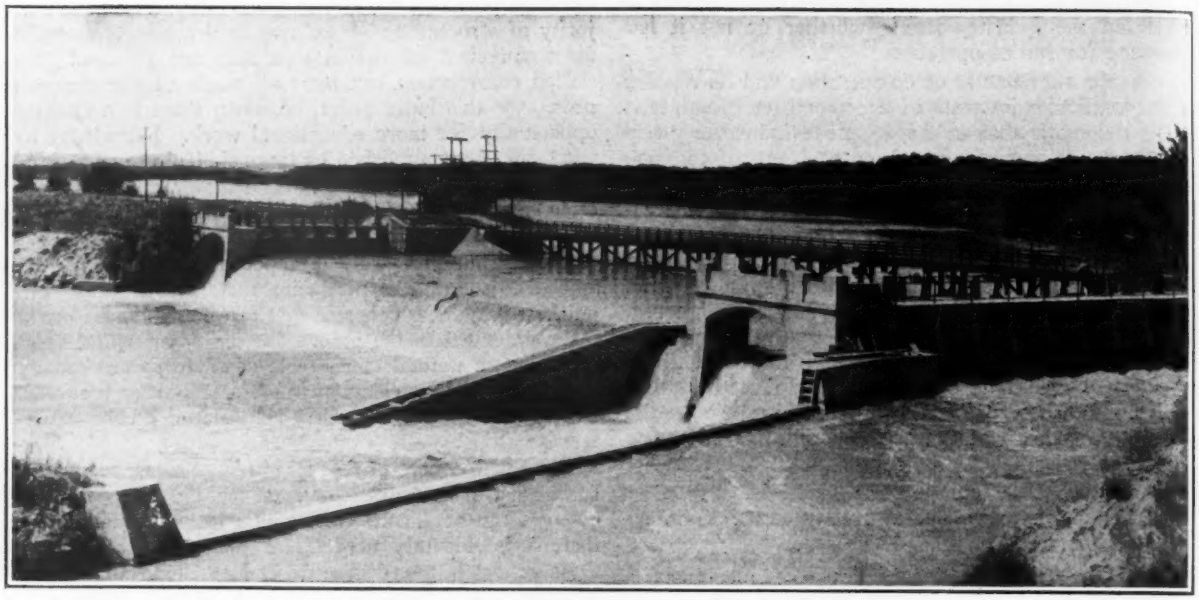


FIG. 1—WHALEN DAM AND CANAL INTAKES

SAND troubles at the Whalen diversion dam on the North Platte irrigation project of eastern Wyoming and western Nebraska have been solved by the construction of a settling basin, skimming weir and sluiceway on the Fort Laramie Canal a short distance below the intake. Frequent observations of conditions below the skimming weir, made since the completion of the desilting works in the spring of 1925, have shown no appreciable depositions of sand to have taken place anywhere along the canal. Prior to the construction of the works, accumulations of material were being formed almost continuously throughout a length of canal extending several miles downstream from the intake.

The Whalen diversion dam is a concrete ogee structure, approximately 35 ft. high and 300 ft. long, completed in 1909 at a total cost of $290,000. It is located at the upper end of the project, about 30 miles northwest of Torrington, Wyo., where it diverts water into the Interstate and Fort Laramie canals. Just above the dam the river makes a sharp bend to the right, changing its course from a northerly to an easterly direction through an angle of about 90 deg. Consequently, the dam is located on approximately a north and south alignment. Fig. 1 is from a photograph of the dam looking in a southwesterly direction from a point near the north end.

The headworks structure for the Interstate Canal is located at the north end of the dam, at right angles to the line of the crest. Nine openings, 5 ft. 9 in. wide by 6 ft. high, controlled by cast-iron slide gates, admit water to the canal; while two openings of the same size, located in the body of the dam downstream from the regulating gates, are utilized in sluicing sand away from the upstream side of the headworks. The headworks structure for the Fort Laramie Canal, built at the south end of the dam, is similarly designed and located except that it is fitted with seven regulating gates instead of nine. The Fort Laramie Canal supplies an irrigable area of 107,000 acres, while the Interstate Canal supplies an irrigable area of 130,000 acres.

The North Platte River, in the vicinity of the North Platte project, carries comparatively heavy loads of sand, both in suspension and as a bed load, during practically the entire irrigation season. Because of the bend in the river above the dam, a pronounced eddy and a reduction in velocity occurs in front of the Fort Laramie Canal headgates, resulting in an aggravation of sand troubles at the south end of the dam. These troubles are always more pronounced during a falling stage in the river than during other conditions of flow. Serious sand troubles have never been encountered at the Interstate Canal intake, since it is located at the outside of the bend where the velocities are comparatively high and where deposition does not occur to any appreciable extent. The slight deposition that sometimes takes place in front of the Interstate gate openings farthest from the dam has at times been removed and prevented from recurring by anchoring a 30-in. pipe in front of the gate sills, running the pipe from the upstream gates to the sluice gate opening so that water will be drawn through the pipe at a comparatively high velocity from the space immediately in front of the upstream gates.

It was not until the summer of 1917 that the sand problem became acute in the upper reaches of the Fort Laramie Canal. Prior to that time no appreciable quantities of water had been diverted for use in the Fort Laramie unit. From 1917 until 1924 various methods of

sand control were tried with comparatively little success. Concrete conduits built in front of the headgates after the manner of the pipe arrangement, used so successfully at the Interstate Canal heading, soon became clogged by the rapid accumulations of material. A new heading constructed a short distance above the dam was rendered inoperative a large part of the time due to shifting of the sand deposits. A sand trap of nominal size, located approximately 0.6 of a mile below the dam, was entirely too small to be effective. Finally, in the summer of 1924, it was decided to design and construct an elaborate system of sand-control works such as would satisfactorily solve the sand problem for the maximum operating conditions to be expected in the future as well as for the conditions then existing.

Design of Sand-Control Works—Briefly, the sand-control works include a settling basin approximately 600 ft. long and 150 ft. wide, with the upper end about 400 ft. downstream from the headgates; a curved skimming weir about 305 ft. long; a sluiceway structure fitted with three 15x15-ft. radial gates; and a sluiceway channel 450 ft. long leading to the North Platte River. The sluiceway structure is located just above the lower end of the skimming weir so as to obtain a more definite scouring effect along the upstream side of the weir. Fig. 2 shows a general plan and elevation of the desilting works, a cross-section of the skimming weir and a longitudinal section along the center line of the sluiceway structure. Fig. 3 shows the skimming weir and settling basin, looking upstream from a point on the east bank of the canal just below the desilting works. Fig. 4 is a view looking

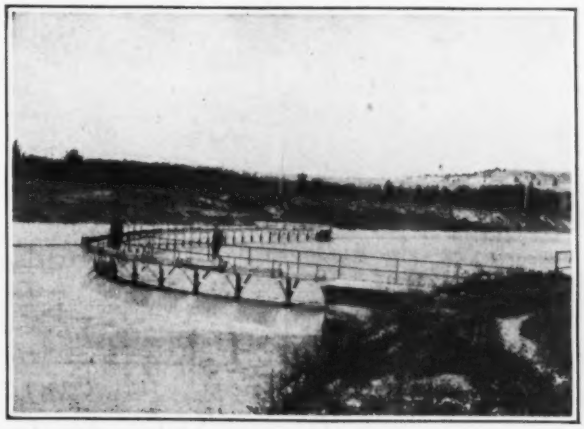


FIG. 3— SKIMMING WEIR AT LOWER END OF SETTLING BASIN

toward the upstream side of the sluiceway structure showing the piers, radial gates and operating platform.

The works were designed for an ultimate canal diversion of 2,000 sec.-ft. and a sluicing discharge of an equal amount. With this quantity of water flowing through the settling basin, with no sand deposits on the floor and with all sluice gates closed, the average velocity through the basin is about 1.25 ft. per second. This value is sufficiently low to permit the dropping of the bed load and the deposition of the suspended sediment in the 600-ft. length of basin which must be traversed, inasmuch as the material being transported is a comparatively coarse sand

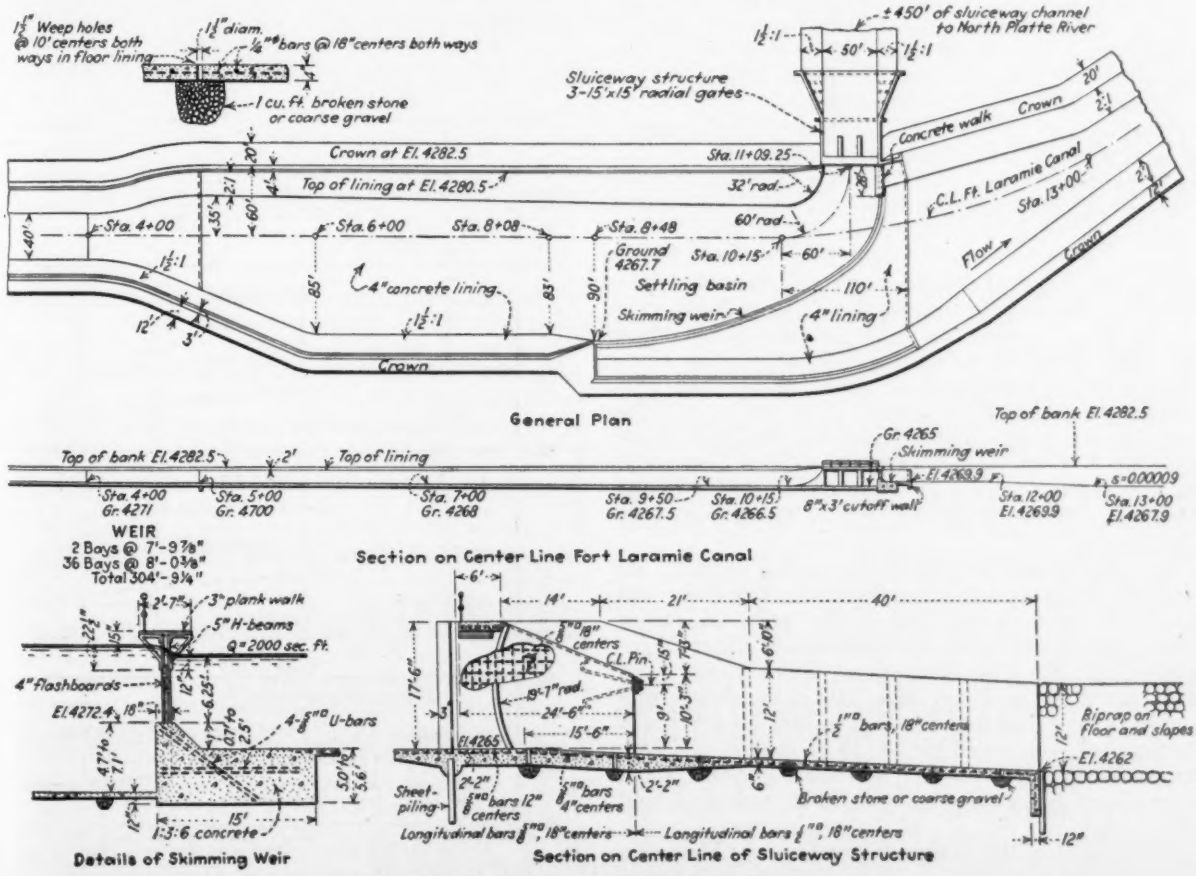


FIG. 2—DETAILS OF THE SAND-CONTROL WORKS

FIG. 4—UPSTREAM END OF SLUICE GATE STRUCTURE

which settles rapidly. Moreover, the long skimming weir draws the water from the upper 2 ft. of depth, while the total depth above the weir for a discharge of 2,000 sec.-ft. is approximately 13 in. Thus far, the canal discharge has not exceeded 1,500 sec.-ft., so that the velocities have been somewhat lower than those used in the design.

Sluicing velocities vary with the discharge during sluicing operations, also with the quantity of material accumulated in the basin. Computations made during the design of the works, assuming the basin to be free from sand deposits, indicate that velocities of from 5 to 17 ft. per second occur in different parts of the basin during a sluicing discharge of 2,000 sec.-ft. However, careful observations of the erosion which takes place during sluicing show that the sand accumulations are seldom, if ever, completely removed in the maximum permissible sluicing period of 45 minutes, a period which cannot be appreciably increased without interfering with the regulation and delivery of irrigation water.

The wide downstream base of the skimming weir, shown in Fig. 2, was necessary in order to provide for uplift pressures. Such pressures may exist during sluicing operations, due to the dropping of the canal water surface; or when flashboards are left in place in the winter when only a small flow is being diverted to the canal. The length of skimming weir and allowable height of flashboards were designed so that the drop-down curve which takes place when the sluice gates are opened draws the water surface in the settling basin down to an elevation lower than the crest of the skimming weir, thus preventing the muddy sluicing water from passing over the weir into the canal. The H-beams and steel reinforcing hold the 4-in. flashboards in place, while a 3-in. plank walk at the top, with a 7-in. gap immediately over the H-beams, permits the easy insertion or withdrawal of the flashboards.

In order to limit erosion in the settling basin during sluicing operations, a 4-in. reinforced-concrete lining was placed on the floor and sides of the basin. A similar paving was placed on the floor and sides of the canal for a short distance downstream from the skimming weir, an 8-in. x 3-ft. cutoff wall being built at the downstream end so as to prevent undermining. Lining reinforcement consisted of ¼-in. round bars at 18-in. centers, laid both ways. Weep holes, underlain by broken stone or gravel, were placed in the floor lining at 10-ft. centers in both directions.

The bottom of the sluiceway structure was built on a comparatively steep slope so as to facilitate sand movement, a drop of 3 ft. being provided between the gate sills and the lower end of the concrete floor, as shown in Fig. 2. Cutoff walls of steel sheet piling were placed at both ends of the structure. At the upper end of the sluiceway the floor and sides of the channel were connected with the floor and slopes of the settling basin, while at the lower end heavy riprap paving was placed on the floor and slopes of the channel for a distance of 25 ft. beyond the cutoff wall. The bottom of the channel at the lower end of the sluiceway structure was placed at an elevation of 4,262, which is about 2 ft. lower than low water surface in the river and 18 ft. lower than the present crest of the diversion dam. The crest of the diversion dam was raised 1 ft. during the spring of 1924 in order to facilitate diversions to the Fort Laramie Canal, three 3x12-in. timbers being bolted together and fastened to the concrete crest by 2-in. square iron pins anchored in the concrete.

Operation of the Works—Thus far the operation of the sand-control works has been entirely satisfactory. Project Superintendent H. C. Stetson, in a letter dated Nov. 15, 1927, from which the greater part of the following information on operation has been abstracted, says: "The operation of the settling basin and the sluice gates has been very satisfactory in every respect and we know of no change which could have been made in the design to render the structure more satisfactory." While the sand accumulations are seldom completely removed from the entire floor of the basin, as previously stated, they are removed to such an extent that three 45-minute sluicing periods a week usually are sufficient to keep all sand out of the canal. Samples of the water passing over the weir have been taken at times and have been found to contain only a trace of sand.

The sand does not usually accumulate between sluicings to an elevation higher than the crest of the concrete weir.

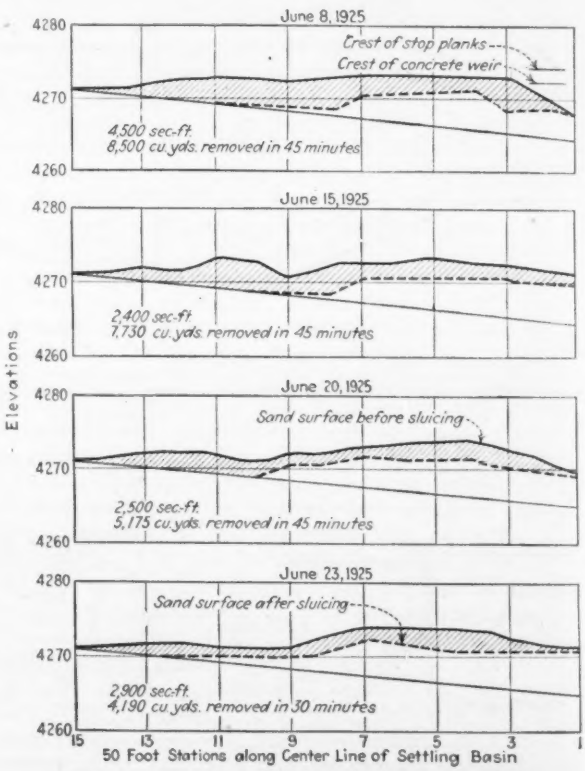


FIG. 5—TYPICAL RESULTS OF SAND SLUICING

During normal canal operation, 56 in. of stop planks is required to create a satisfactory difference in elevation between the water in the settling basin and the water in the canal. Consequently the surface of the sand deposits is usually 4.5 ft. or more below the operating crest of the skimming weir. While the sand appears to be deposited rather uniformly over the entire floor of the basin when the sluice gates are closed, the erosion which takes place during sluicing periods proceeds rather irregularly, thus resulting in an irregular profile of sand deposits throughout the basin.

Fig. 5 shows the results of some measurements made before and after the sluicing periods of June 8, 15, 20 and 23, 1925. Profiles of sand deposits along the center line of the basin before and after sluicing, sluicing discharges, duration of sluicing periods and total quantities of material removed are indicated on the diagrams in each case. Crest elevations of stop planks and of concrete weir are shown on the diagram for June 8, but are not available for the other dates. It will be noticed that from 4,190 to 8,500 cu.yd. of sand was removed by discharges of from 2,400 to 4,500 sec.-ft., maintained during periods of from 30 to 45 minutes. Sluicing results are less satisfactory during periods of high river flow due to the smaller drop in water surface between the upstream side of the dam and the outlet of the sluiceway channel. Most effective results are obtained with sluicing discharges of from 2,500 to 3,000 sec.-ft. at times when the entire flow of the river is being diverted to the Fort Laramie and Interstate canals. At such times approximately 16 ft. of head is available for creating and maintaining high velocities through the 1,600-ft. length of canal, settling basin and sluiceway channel which must be traversed from the headworks structure to the river.

One of the interesting things shown by the diagrams is that relatively large quantities of material are removed from the upper end of the basin where the accelerated flow from the lined canal above has its first opportunity to pick up an additional load of sediment. A length of from 250 to 300 ft. at the upper end of the basin was entirely cleaned of sand deposits by the 45-minute sluicing periods of June 8, 15 and 20, while a length of 100 ft. was cleaned by the 30-minute sluicing period of June 23. The erosion of the deposits seems to progress more or less irregularly from both ends of the basin toward the center, especially during the early part of the sluicing period. Frequently the sand deposits break down near the sluice gates, and the erosion, accompanied by a sand wave similar to those which often occur in steeply inclined natural channels during flood periods, proceeds upstream as fast as a man can walk. When one wave has progressed some distance upstream, another forms at the gates, and so on. The photograph reproduced as Fig. 6 illustrates typical sand wave conditions near the lower end of the settling basin during a sluicing discharge of approximately 3,000 sec.-ft. The diagram for June 8 indicates that a sand wave had progressed upstream as far as station 3 when the sluicing operations were discontinued. Usually there is a tendency for the current to be strongest on the side next to the skimming weir.

FIG. 6—SAND WAVE IN SETTLING BASIN DURING SLUICING

The sluice gates at the lower end of the settling basin are operated only during the irrigation season, which begins about May 1 and ends about Sept. 30. During the non-irrigation season flashboards are inserted at the headgates of the canal to serve as a skimming weir so that the 150 sec.-ft. of water needed for the Lingle power plant can be diverted without carrying appreciable quantities of sand into the desilting works. At such times accumulations of material in front of the headgates are prevented by operating the two sluice gates in the dam, using as much as 300 sec.-ft. of sluicing water whenever an ample supply is available. Of course, any sand that happens to pass the flashboards at the headgates is deposited in the settling basin and sluiced back to the river when sluicing operations are begun the following spring.

Construction Methods—The construction of the sand-control works had to be carried on during the winter months so as not to interfere with the delivery of irrigation water. It was also important to hasten the completion of the work as much as possible on account of the Lingle power plant, which is located at a drop in the canal about 20 miles below the intake and which had to be

TABLE I—COST OF REINFORCED-CONCRETE CONSTRUCTION

Element of Cost	Cost Per Cubic Yard	Total Cost
Preparatory work	$0.65	$2,011.37
Preparing foundation	0.46	1,409.18
Cement, including freight and hauling	4.01	12,387.63
Coarse and fine aggregate, including screening and hauling	0.75	2,316.46
Heating materials	0.26	800.00
Mixing and placing	1.67	5,162.82
Forms, labor	1.10	3,398.64
Forms, material	1.01	3,121.61
Reinforcing steel,* including hauling, cutting, bending, and placing	1.49	4,600.25
Finishing	0.26	804.09
Sprinkling and protecting	0.21	648.81
Water	0.32	996.36
Minor equipment, supplies and miscellaneous	0.46	1,425.44
Equipment charge	0.55	1,715.00
Totals for 3,090 cu.yd.	$13.20	$40,797.66

*97,054 lb., or 31.4 lb. per cubic yard.

shut down during the progress of construction. Actual work was started in October, 1924, and was finished on April 2, 1925. Although the weather during the first two months was favorable for rapid progress, the larger part of the work had to be done under very cold and trying conditions.

Excavation and backfill at the site of the works, also excavation of a drain to the river to assist in unwatering the site, were done by dragline, four machines being used. On account of the great width of the settling basin, it was necessary to rehandle approximately 117 per cent of the excavated material.

The lower part of the excavation consisted of a good grade of sand and gravel suitable for concrete, and about half of the aggregate needed for the concrete construction was obtained from this source. The other half was secured at a pit about a quarter of a mile distant, where it was loaded by a wagon loader and hauled to the site in dump wagons. Warm water was used in the concrete mix during the cold weather. Cement, reinforcing steel, structural steel, gates and rock were shipped to the Whalen railroad siding about a mile from the Whalen dam, and were hauled to the job by truck.

A sump was put down at a suitable location and two 10-in. centrifugal pumps were installed for unwatering the site, one of which was operated continuously. Two 40-hp. boilers were used to operate the pumps and to furnish warm water for the concrete. The unwatering of the site was a costly part of the work, since the installation of the concrete paving over the floor of the settling basin required the unwatering of a comparatively large area.

Cost Data—Careful cost records were maintained throughout the construction of the works. Table I gives the different items of cost involved in the reinforced-concrete construction; Table II gives the quantities, unit costs and total costs for the different parts of the entire job. The total cost of the works amounted to $97,250, a figure $12,750 less than the engineer's estimate. The cost of camp maintenance was 3.1 per cent of the total, engineering and inspection cost was 4.1 per cent, superintendence and accounts 3.3 per cent and general expense 4.7 per cent.

TABLE II—PRINCIPAL ITEMS OF COST

Class of Work	Total Quantity	Unit	Total Cost	Unit Cost
Cofferdams	.....	Job	$13,155.17	.....
Excavation, wet, hand methods	400	Cu.Yd.	892.87	$2.23
Excavation, machine methods	55,500	Cu.Yd.	12,128.00	0.22
Excavation, machine methods, drain	6,100	Cu.Yd.	502.07	0.08
Steel sheet piling	1,300	Lin.Ft.	1,214.72	0.93
Reinforced concrete	3,090	Cu.Yd.	40,797.66	13.20
Structural steel and metal work	15,000	Lb.	1,255.34	0.08
Woodwork, including freight and hauling	12,000	M.B.M.	743.23	61.90
Backfill, dry, hand and team	1,000	Cu.Yd.	737.70	0.74
Backfill, puddled	200	Cu.Yd.	355.37	1.78
Riprap	240	Cu.Yd.	823.28	3.72
Gates and hoists, including freight and hauling	65,000	Lb.	9,844.84	0.15
Camp maintenance	.....	.....	3,000.00	.....
Engineering and inspection	.....	.....	4,000.00	.....
Superintendence and accounts	.....	.....	3,200.00	.....
General expense	.....	.....	4,600.00	.....
Grand total cost			$97,250.25	
Estimated total cost			$110,000.00	

Laborers were paid from $3.20 to $3.52 per day, carpenters from $5.12 to $6, teamsters with two horses $5.44, mechanics and blacksmiths $5.44, dragline operators $5.12 to $6.88, dragline oilers $4, and the foreman $225 per month. Material costs, delivered at the job, were $0.72 per sack for cement, $0.03 per pound for reinforcing steel and $30 per thousand board-feet for lumber.

The work was done under the general supervision of Andrew Weiss and H. W. Bashore, project superintendents, Mr. Bashore being appointed superintendent when Mr. Weiss was transferred to the Denver office in January, 1925. The designs were prepared under the general direction of J. L. Savage, chief designing engineer. All engineering and construction work of the Bureau of Reclamation is under the direction of R. F. Walter, chief engineer, with headquarters at Denver, Colo., and all activities of the bureau are under the general charge of Dr. Elwood Mead, commissioner, with headquarters at Washington, D. C.

Automatic Hydro-Electric Control at Baltimore Sewage-Works

Large Saving in Labor and Total Operating Cost of Plant Which Utilizes Head of Final Effluent for Power

By C. E. Keefer
Engineer of Sewage Disposal, Bureau of Sewers, Baltimore, Md.

AN INTERESTING and novel feature of the Baltimore sewage-works is the hydro-electric plant which generates power from the fall of the treated sewage. Recent substitution of automatic control at this plant has cut the operating staff 86 per cent and the cost of current 68 per cent.

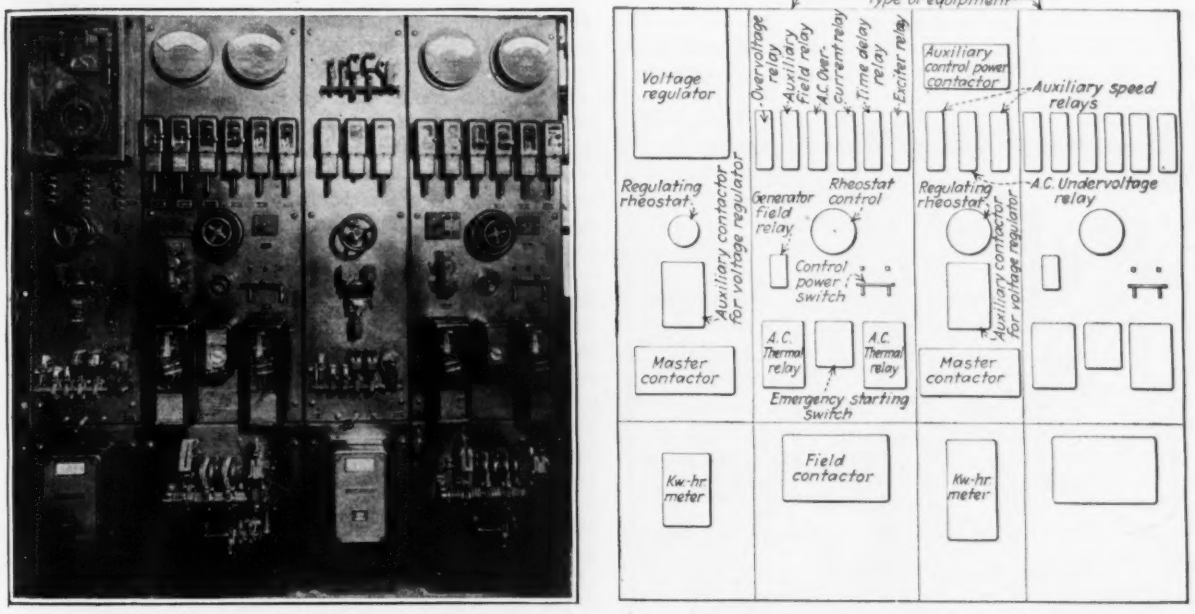
When the Baltimore sewage-works was built, no electric power was available within several miles. The flow line of the final settling tanks had been put 20.5 above Back River, into which the effluent is discharged, in order to give sufficient head for intermittent sand filters if and when necessary, which had never been the case. Consequently, the head was utilized for power. Previous to January, 1925, the hydro-electric plant generated all the current used at the sewage-works. Since then it has been necessary to purchase additional power from the local power company. During 1927 a total of 441,550 kw.-hr. was used, of which 31,490 kw.-hr. (7 per cent) was bought.

The hydro-electric plant consists of two 110-kva. generators, direct-connected to two horizontal waterwheels. The average head is 18 ft.; the flow during recent years has averaged from 50 to 60 m.g.d. Until June, 1925, when work of putting in automatic control was begun, four engineers and three oilers were employed to operate the plant. With this personnel one engineer and one

oiler were on each watch of eight hours, with an additional engineer as a relief.

In 1924 a study was made of the cost of generating current at the sewage-works as compared with the cost of buying it, current in the vicinity then being available. By purchasing all the current a saving of approximately 40 per cent would have been possible. About this time automatic control equipment for small hydro-electric plants was coming into general use. It was recognized that if this equipment could meet the demands placed upon it, the personnel at the Baltimore power station could be reduced from seven men to one man and that current could be generated considerably more cheaply than it could be bought. Therefore automatic control equipment was purchased from the General Electric Company.

Control Equipment—The control equipment is designed so that either of the two generators can be started manually by closing a small single-throw switch. A relay



AUTOMATIC CONTROL EQUIPMENT OF HYDRO-ELECTRIC EQUIPMENT, BALTIMORE SEWAGE-WORKS

is thus energized, and the gates in the waterwheel open. The treated sewage then flows through the turbine and the generator comes up to speed. When 95 per cent of full speed is attained, the main switch automatically closes and the generator takes the load. By means of a number of relays, thermocouples, etc., the generators are protected against under- and over-speed, hot bearings, under- and over-voltage, and overload. In case any of these undesirable conditions occur, the generator shuts down automatically. After a short interval of time the second generator starts up automatically. The time interval between the shutting down of the first machine and the starting of the second can be regulated at from four seconds to 35 minutes. Whenever either generator shuts down, an alarm bell rings in a building 2,200 ft. away, where an operator is always present.

The greater portion of the automatic control equipment is mounted on four panels as shown in the accompanying view. All of the wiring and apparatus on these panels is for 220-volt service. Platinum contacts are used on the various relays, etc., so as to obviate the corrosive effect of any sewage gases. The total cost of the equipment as installed was $8,907. Work was begun in June, 1925, and was completed in February, 1926.

The automatic equipment has given good results. One operator, who has had no training as an electrician, looks after the plant. During the sixteen-hour period each day that he is off duty the watchmen at the sewage-works make one or two inspections of the power station. No money has been spent for repairs on the equipment during the two years it has been in use. All of the control devices for each generator are tested once every other week to see that they function properly. So far none of them has failed to operate.

COST OF GENERATING ELECTRIC POWER, BALTIMORE SEWAGE-WORKS

Year	Cost of Operation: Materials	Labor	Total	Current Generated, Kw.-Hr.	Cost Per Kw.-Hr., Cents
1920	$384	$11,260	$11,645	306,300	3.80
1921	781	11,530	12,311	261,990	4.70
1922	1,241	10,487	11,728	351,030	3.21
1923*	676	10,946	11,622	348,640	3.34
1924*	405	11,133	11,538	320,800	3.36
1927*	468	4,488	4,956	410,060	1.21

*Includes supervision.

Cost of Operation—The cost of operating the power plant, the quantity of current generated and the cost per kilowatt-hour are shown in the accompanying table for the years 1920 to 1927, exclusive of 1925 and 1926, when the power plant was out of service for a considerable portion of the time pending the installation of the automatic equipment and the making of other improvements. During the five-year period, 1920-24, the average cost was 3.7c. per kilowatt-hour, whereas the cost for 1927 was 1.21c., a reduction of about 68 per cent. It is expected that the cost during 1928 will be considerably less than in 1927, as an unusual number of improvements were made during the latter year.

The Baltimore sewage-works is under the general supervision of C. F. Goob, chief engineer, and M. J. Ruark, sewerage engineer. The writer has charge of the operation and the design of the plant, and G. K. Armeling is the superintendent.

Building an Airport at Portland, Oregon

Island in River Provides Ideal Site, Level, Free From Obstructions and Close to City—Graded by Filling With Dredged Material From Ship Channel

By James H. Polhemus
General Manager, Port of Portland, Portland, Ore.

SWAN ISLAND, the site of the Port of Portland airport at Portland, Ore., was originally a low, timber-covered island in the Willamette River and was acquired by the Port of Portland Commission in 1921 as a part of a harbor improvement project. The principal objective was to open up a fairway on the west side of the island where previously there was only about 4 ft. of water. The ship channel on the easterly side was 35 ft. deep but was narrow (300 to 400 ft.) and contained a sharp, blind turn. The new fairway on the west side of the island was dredged 1,500 ft. wide to a depth of 35 ft. at low water.

When this project was well advanced and after considerable of the dredged material had been deposited

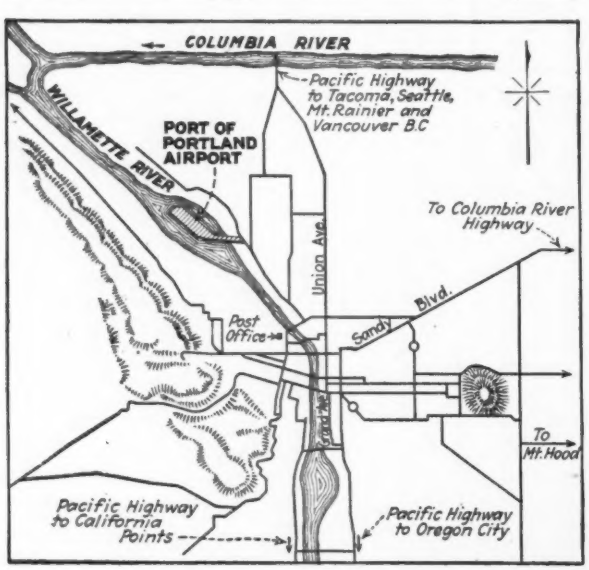


FIG. 1—LOCATION OF PORTLAND AIRPORT

upon the island, demand for an airport site became urgent. Since an airport requires a considerable area of level land and, to be of any real service to commercial aviation, must be reasonably close to the business district of a city, Portland was faced with a serious problem. Such sites are worth from $5,000 to $20,000 an acre, and a considerable acreage must be acquired in order that the landing field may be free from bordering obstructions such as buildings, smokestacks and pole lines, and in addition may afford the long runways that are desirable for large or heavily loaded planes.

To provide such an airport the civic organizations prevailed upon the commission to make Swan Island available. It was apparent that no great difficulty would be involved in connecting the island to the mainland. Its location was ideal, both in proximity to the business center and in accessibility from the air, and it was completely free from obstructions, since it was surrounded by water. Another advantage was that the Willamette River acts as a permanent marker or guide, as also does the Columbia River, which the Willamette joins about 5 miles below the harbor. The gorge of the Columbia River through the Cascade Mountains has been found to be a natural airway leading from the east. The new airport is therefore at a convenient center for air travel not only north and south along the coast route but east and west through the gorge of the Columbia.

By connecting the island to the mainland, bringing all of the surface to a suitable elevation by hydraulic dredge fill (including the connecting land reaching the main highway on the east side), the area usable for airport purposes will be approximately 250 acres. At this writing about 80 acres has been finished off and a very good sod grown on it.

After the commission had consented to make this harbor island available, the work necessary to be done consisted in removing a heavy growth of timber from about 150 acres, filling the entire surface from the existing elevation of about 15 ft. to a level grade of 32 ft. above low water (25 ft. is considered freshet high-water level at Portland) and connecting the island by means of a filled causeway to the east mainland, thus blocking off the upper end of the old ship channel. The latter involved the purchase of land on the east side to which to connect the causeway, 550 ft. of water frontage, reaching back to the nearest street, being acquired. The filled causeway will have a top width of about 230 ft. after allowing for the slopes. That portion which lies in the old ship channel will require about 67 ft. of fill. Incidentally, an act of Congress was required to permit placing a fill across the old channel, and specifications required that three 48-in. culverts be set in the causeway to allow a flow of water into the dead water basin formed of the old channel; also a 42-in. sewer which terminated at the site where the causeway meets the mainland had

FIG. 2—SWAN ISLAND IN WILLAMETTE RIVER, SITE OF PORTLAND AIRPORT
The connection to the mainland and the necessary fill on the island was made from material dredged from the new ship channel on the right.

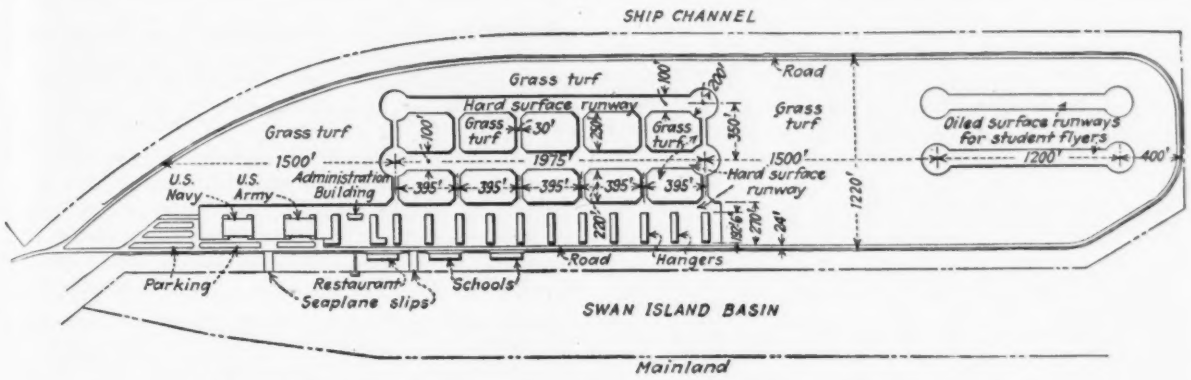


FIG. 3—LAYOUT OF AIRPORT FACILITIES ON SWAN ISLAND, PORTLAND, ORE.

to be extended diagonally through the causeway a distance of about 500 ft., so that it would discharge into the main river current and not into dead water.

For the permanent grass turf, red top, blue grass and creeping bent, the latter being native to the coast country of Oregon, were sowed. To protect these slower-growing grasses during the first year a cover crop of fast-growing rye grass was sowed at the same time. This will die out when the permanent grasses mature. A total of about 150 acres will be grass grown and suitable for the landing of planes. However, a prepared runway is being provided which is intended to be used regularly or at least until the grass turf is well matted and strong enough to permit the landing and taking off of the planes without damaging the turf. The runways are each 100 ft. wide and 1,500 ft. long and lie parallel to each other with the long dimensions conforming to the general wind directions, which are either northwest or southeast—that is, up and down stream of the Willamette River. The runways are built of clay soil into which 4 in. of crushed gravel is rolled with a top dressing of fine crushed rock mixed with a patent binder of asphaltic mixture. The layout is shown in Fig. 3, which also shows the location of hangars, etc.

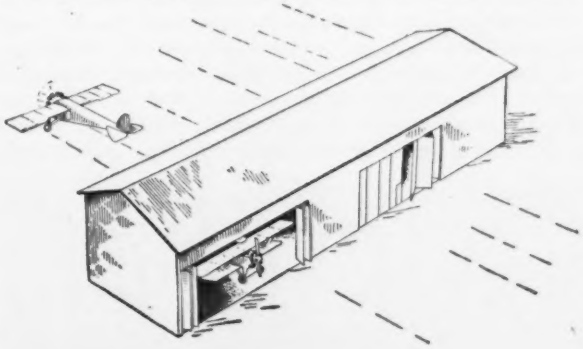
Hangars—To start with, it is planned to construct several of the Bundy-type hangars, Fig. 4, upon which the inventor, Carey Bundy, has made application for a patent. Some of the features of this type of hangar are:

1. Its first cost is low, since there are no long spans requiring costly trusses, and the door construction is simple and inexpensive.
2. It can be made up in sections.
3. It is portable.
4. It allows each plane to be removed without the necessity of moving others.
5. The fire risk is limited to but one plane.
6. Individual plane owners can have their own workshop, tools, etc.
7. Independent lighting and heating of the various hangar stalls is practicable, and expensive heat-insulating material used for large areas can be eliminated.
8. The hangar capacity can be increased as the demand justifies and no investment need be made in large hangars which might not be fully utilized.

It is estimated the Bundy-type hangar can be built in several sizes accommodating the various sizes of airplanes that will use the airport and effect a saving of at least 50 per cent in the cost of hangar construction.

Dredging and Filling—Since the island required a fill 17 ft. on the average and 30 ft. at the shore line and since it was necessary that the material be confined upon the island surface, a plan was evolved to build first a sand dike around the periphery of the island, thus forming a large settling basin over the entire surface into which sand, clay and river silt from the channel could be pumped by the hydraulic dredges. Sand was chosen as the material, since it could easily be deposited in a dike with restricted slopes, the outer slope not encroaching upon the navigation area and standing permanently against the erosion of freshet currents and the wash of passing vessels.

This diking was deposited from traps in the dredge pipe, which was placed upon a trestle. The pipe was 30-in. diameter made of No. 10 steel in 20-ft. lengths and had slip joints. In each length of pipe there was a slot or trap with a sliding gate so that the opening could be regulated as desired, from a mere slit to a 6-in. square opening. When sand is being dredged, it naturally flows in greatest quantity along the bottom of the pipe. By opening a number of traps at the points desired, the sand, with a relatively small percentage of water, dropped out, while the great volume of water continued through the pipe. The sand buried the trestle as it piled up and maintained very uniform and fairly steep slopes. The discharge of water at the end of the pipe, containing a very small proportion of solids, was allowed to flow



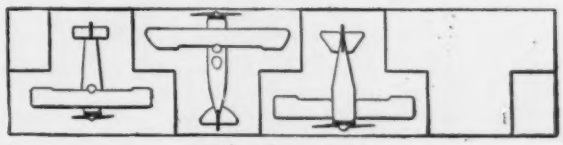


FIG. 4—TYPE OF HANGAR USED AT PORTLAND AIRPORT

over the surface of the island and to return to the river at open places in the dike or through a spillway under the dike. This spillway, Fig. 5, placed before the dike was built, was composed of five lines of old 30-in. dredge pipe, the inside ends being flanged to the face of a bulkhead and the pipes extending beyond the outer line of the sand dike.

Following completion of the encircling dike, the discharge of two dredges was deposited in the inclosed area, the material being taken as encountered in making the channel cut. The sand precipitated close to the discharge pipe, whereas the clay carried for a long distance and settled slowly. As the fill built up around the end of the discharge pipe, the pipe was extended upon the made ground until the whole area was filled. A number of discharge pipes were used. The practice was to place Y-branches in the line so that from one dredge a series of shore lines could spread out, spaced about 250 ft. apart. By closing gates in the Y's the discharge could be sent through any one of the shore lines and by alternating the flow the fill could be brought to grade concurrently over a wide area.

To prevent the fill from blocking the intake end of the spillway, a crib, or bulkhead, was built around it. As the fill built up, the bulkhead was also raised. The surplus water flowed down through the crib to reach the spillway pipes at the bottom. It is a simple matter to fill this cofferdam when the spillway is no longer required. The old dredge pipes are allowed to remain in the ground, as they are buried to a depth of from 20 ft. to 30 ft.

Two 30-in. hydraulic dredges were used on the Swan Island job. The "Clackamas" is a Diesel-electric plant delivering 3,400 total horsepower from the prime movers and applying 2,700 hp. to the motor driving the dredging pump. The "Tualatin," a steam plant, has two 1,000-hp. turbines driving the dredge pump through reduction gears. The normal impeller speed on both is 300 r.p.m. As it was desired to grow a grass sod on the island to make it suitable for an airplane landing field, it was necessary to provide a top dressing over the main fill, which was mostly sand. For this reason the main fill was brought to a subgrade, about 2 ft. below the final grade, leaving a shallow basin surrounded by the berm of the sand dikes. Into this basin clay and river silt were discharged by the dredges, the work being done carefully to avoid washouts and to allow this light material to settle in the inclosed area. By this method a fairly good soil was procured. The principal difficulty was that in the center, where the ground was highest, the proportion of sand was somewhat greater. The ground was purposely left higher in the center, the crown being about 5 ft. to afford good drainage. This is greatly aided by the fact that the main body of the fill is of sand. Drainage is very necessary in this district because of the relatively high precipitation during the winter.

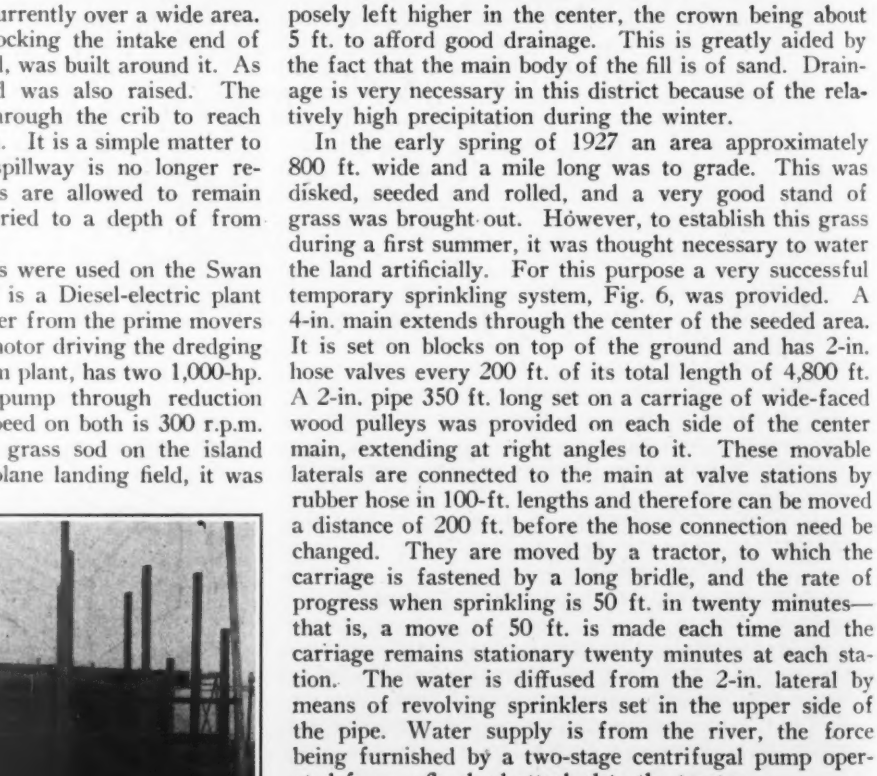


FIG. 6—TEMPORARY SPRINKLER SYSTEM TO BRING GRASS THROUGH ITS FIRST SUMMER

In the early spring of 1927 an area approximately 800 ft. wide and a mile long was to grade. This was disked, seeded and rolled, and a very good stand of grass was brought out. However, to establish this grass during a first summer, it was thought necessary to water the land artificially. For this purpose a very successful temporary sprinkling system, Fig. 6, was provided. A 4-in. main extends through the center of the seeded area. It is set on blocks on top of the ground and has 2-in. hose valves every 200 ft. of its total length of 4,800 ft. A 2-in. pipe 350 ft. long set on a carriage of wide-faced wood pulleys was provided on each side of the center main, extending at right angles to it. These movable laterals are connected to the main at valve stations by rubber hose in 100-ft. lengths and therefore can be moved a distance of 200 ft. before the hose connection need be changed. They are moved by a tractor, to which the carriage is fastened by a long bridle, and the rate of progress when sprinkling is 50 ft. in twenty minutes—that is, a move of 50 ft. is made each time and the carriage remains stationary twenty minutes at each station. The water is diffused from the 2-in. lateral by means of revolving sprinklers set in the upper side of the pipe. Water supply is from the river, the force being furnished by a two-stage centrifugal pump operated from a flywheel attached to the tractor.

During one month a total of 1,027,250 cu.yd. of material (sand, clay and gravel) averaging 16.4 per cent solids was pumped by the 30-in. Diesel electric dredge. The average pipe-line length was 2,598 ft. and the average elevation of the discharge 31.6 ft. This output was a record for all Port of Portland 30-in. dredges, of which there are four.

FIG. 5—SPILLWAY OF FIVE 30-IN. PIPES FOR DRAINING THE DREDGE WATER FROM THE CONFINED BASIN ON THE ISLAND

Operating Problems of Pneumatic Alum Conveyor System

Rotary Locks Accumulating Stiff Paste, Reducing Clearance, Replaced by Gate Locks—Hose Substituted for Metal Bends

By J. Arthur Jensen
Engineer, Water-Works Department,
Minneapolis, Minn.

IN THE new Fridley filtration plant at Minneapolis a pneumatic filter alum conveyor was installed for unloading granulated alum in bulk from cars to storage or service bins. (*Engineering News-Record*, May 13, 1926, p. 766.) This conveying plant, probably the first of its kind for handling alum, has been in service for a little more than a year and some inquiry has been made as to its action in operation and the possible development of troubles.

Two difficulties have arisen due entirely to the nature of the material and the lack of experience in handling it under the conditions imposed. Certain peculiarities of alum transported at high velocities and its action on frictional surfaces may be of interest to those who might contemplate the use of this mode of conveying this material, as they may thereby readily avoid the difficulties which have come to light here.

The handling of alum is disagreeable and distressing to the men who come in direct contact with it. Pneumatic conveying obviates practically all of this objectionable feature, because the alum is moved through a closed system. Some dust is encountered in the cars when the closely packed material sloughs and flows to the suction nozzles. No workmen are required at the delivery bins, except in case of trouble, so that the dust there will settle quietly without any of the usual discomfort to the men.

Originally this plant was equipped with rotary locks for the delivery of the alum from the receivers to atmospheric pressure and the pipe lines were run with very easy bends. It was found that the alum gave trouble, both at the locks and at the bends.

Rotary Locks Replaced—The tightness of the rotary locks depends upon the closeness of the drum bearing and the consequent reduction of leakage to a minimum. Dust entered these sealing or rotating surfaces and was ground by the two faces under pressure into a hard, stiff paste, which continued not only to build up, even though the clearances were eased, but also to create such a friction as to cause breakage of sprockets and drive chains. After oiling strips and dry surfaces and other means were tried it was finally concluded that the rotary lock was not well adapted to the handling of this material due to its frictional properties.

The remedial step was the removal of the rotary locks and the substitution of "step" or gate locks, which open and shut like trap doors. The sealing strip is a yielding packing into which the door closes in a tight fit with a V-shaped ridge or rim. These locks handle the material without any trouble and have proved to be the remedy for the former difficulty encountered.

The trouble at the bends was of a different nature, and for a time the solution was not apparent. It was found that the material would flow in vacuum in a stream well to the center of the pipe and at a high velocity. On reaching the turns the grains were projected against the wall of the pipe on the outside of the turn. This impingement of the grains at the prevailing velocity would leave a slight smear or trace on the iron wall. The countless number of similar smears caused the accumulation or building up of an intensely hard scale, which could not be loosened even by the hardest hammer blows. In time this accumulation reduced the cross-section of the pipe so that the delivery fell below the capacity of the plant. The straight pipe did not appear to be affected.

Rubber Hose for Bends—The remedy for this accumulation at the bends was discovered somewhat accidentally. In the box car the nozzles were attached to ordinary suction hose. This hose was in two parts, joined by a short iron nipple near the center provided with the necessary vent openings to permit adjustment of the air in moving the material. The same accumulation of scale took place at the nipple due to the disturbance of the air admitted at this point, but to a lesser degree than at the bends. It was also found that there was no building up or accumulation on the inside of the hose, because the smear would not adhere to the rubber. The iron bends were then removed and flanged rubber hose substituted. This hose was supported in place by bent channels. The troubles were thus overcome. The capacities were restored and the plant is operating satisfactorily.

The abrasive effects of alum will eventually cut through the rubber lining of the hose, but the material will not build up scale in the hose at the turns.

From this it appears that in designing pneumatic conveying equipment for alum, it is advisable to employ the use of the step or gate locks and make the bends in the conducting pipe lines of rubber hose, or perhaps of rubber-lined pipe. It is, of course, desirable that the delivery lines should be straight, but as this condition is rarely attainable, they should always be made with as few bends as possible.

Continuous Construction Adopted for Lake Champlain Bridge

In designing the interstate toll bridge to be built by New York and Vermont across Lake Champlain, the engineers to the two states, Fay, Spofford & Thorndike, of Boston, are making use of continuous-truss construction. The main portion of the bridge consists of a three-span continuous structure with central span of 434 ft. and two side spans of 290 ft. each; a two-span continuous structure with one span of 270 ft. and one of 225 ft.; and a simple span of 270 ft. In addition, there are plate girder viaduct approaches.

All important foundations of this structure are on rock. The two center piers will have to go 100 ft. below water surface to reach rock. The deck of the bridge is 95 ft. above water at its highest point.

A concrete slab with concrete wearing surface will form the deck. Its roadway width is 24 ft. The total length of the bridge is about 2,200 ft., of which about 1,500 ft. is over water.

As noted in our issue of May 17, p. 794, the substructure contract has been awarded to the Merritt-Chapman & Scott Corporation at $385,000, and the superstructure contract to the American Bridge Company at about $535,000. Substructure bids were asked on either pneumatic caisson or open cofferdam construction, the latter being so specified as to permit either concreting in the dry or concreting in water after preparing the surface of the rock by divers. The successful bid was on open cofferdam construction.

MODERN CEMENTS

A Study of the Characteristics of the Hydraulic Cements

In Two Parts { **Part I—White Cement, Waterproofed and Masonry Cements**
Part II—High-Early-Strength Cements and Standard Portlands

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PART II

High-Early-Strength Cements and Standard Portlands

In the First Part of this article (*Engineering News-Record*, June 7, p. 887) the conditions which brought about the production of new cements were indicated, and three of the five groups of American hydraulic cements were dealt with. We now come to the most widely discussed group, that of high-early-strength cements, which embraces the high-alumina cements and the high portlands. The standard portlands also invite attention. —Editor.

4—High-Early-Strength Cements

TWENTY years ago, when the late Henry S. Spackman, in attempting to produce an agent to accelerate the hardening of lime mortars, and the late Jules Bied, in France, in attempting to develop the ideal cement neutral to the action of sulphate salts and solutions, independently discovered the marked high strength and early hardening of the high-calcium aluminates, they started on its way a reaction regarding standard portland cement which is still gaining momentum. The qualities which they noted in their product seemed to supply, to a marked degree, two characteristics lacking in portland cement—namely, high early strength and resistance to sulphate waters.

Delayed Production—Notwithstanding their claims the high-alumina cements did not appear commercially until during the World War, when they were manufactured in France and used in setting large guns. Following the war there was a short lapse in the interest in them. By 1921 in France and 1923 in the United States they were again being actively promoted commercially.

With this active promotion, others in the portland cement industry, especially those not in control of the patents covering the high-alumina cements, finally became interested in attempting to see if it were possible to make a true portland cement of characteristics equal to those of the high-alumina.

Alumina Cement—Essentially the high-alumina cements are monocalcium aluminates ($CaO.Al_2O_3$). In this country the silica is a minor constituent (about 5 per cent or less) and the iron oxide a relatively important one (present to the extent of 9 to 15 per cent). Abroad, the proportions of these two oxides were reversed at first, but lately they are closer to the quantities used in the United States. In both cases it is not known positively how the silica and iron oxide exist in the cement. The amounts in which the oxides of the several elements exist result in a low melting mixture, which does not easily clinker but which passes from a powdered stage to a fused condition within a very narrow range of temperatures. Thus the alumina cements are fused because they cannot be economically clinkered, and not because high temperatures are of necessity required to bring about the desired combination of the elements.

Their Fusion Temperature—This fusion temperature is about 100 deg. C. less than that at which portland cement is clinkered. The latter is clinkered and not fused, because the fusing temperature is more than 200 deg. C. higher than the clinkering temperature. Such higher temperatures are not attainable in kilns of the type now used, and furthermore it has not been shown that portland cement is improved by heating above the clinkering temperature. Portland cements are rich in silica and very low in alumina and iron oxide as compared with the high-alumina cements, and are essentially a mixture of two silicates of lime ($3CaO.SiO_2$ and $2CaO.SiO_2$).

The Setting Reaction—The reaction of water with high-alumina cement results in the breaking down of the monocalcium aluminate to a hydrated form of the tricalcium aluminate ($3CaO.Al_2O_3$) and hydrated alumina. The reaction in the case of portland cement results in the formation of hydrated silicate of lime, somewhat lower in lime than $2CaO.SiO_2$ and hydrated lime. In the former case the reaction is very rapid, and as a consequence the cement attains by far the greater part of its strength in 24 hours, while with portland cement the reaction is so much slower that in 24 hours it has attained generally but a small part of its final strength.

The High Portlands—The problem in producing a high-early-strength portland cement should be solely that of trying to have the water-cement reaction speeded up at early periods from eight to ten times its present rate. So far the efforts have fallen far short of this, but in a number of cases considerable progress has been made. But in all cases the efforts have been directed toward producing a change in the cement itself which would be indicated by the presence of a greater amount of the high-lime silicate ($3CaO.SiO_2$).

To accomplish this some study has been made of the rôle of alumina and iron oxide in the raw mixtures, the ratio of lime and silica, the effect of fineness of particles of the raw maxture, the temperature and degree of burning, and the fineness of grinding of the clinker. Such meager studies indicated to an extent the relative importance of each of these, and after minor changes in composition and major changes in degree of grinding the high-early-strength cements appeared on the market.

Strength Properties—In Table II certain of the strength characteristics of these and domestic high-alumina cement are given. The data in this table are of especial interest as demonstrating most conclusively

the valuelessness of the mortar test in predicting the strength of the cement in concrete. The high-alumina cements are not strikingly better than the high portlands, according to the tension standard-sand briquet. They appear to better advantage in the compression standard-sand tests, but evidently it is necessary to make concrete tests before these cements can be truly evaluated.

This fact should be borne in mind by both producer and purchaser. Both should discard the small test specimens, and, since they are selling or buying a cement on account of its high early strength *not in the laboratory but on the job*, they should make tests of the concrete such as will be used on the job.

Alumina Cement Unique—The data also show that if one considers 24-hour and 72-hour strengths as significant of what "early" indicates, the high-alumina cements are in a class by themselves and have no serious competition from the high portlands to date. At later ages the portland cements show their characteristic large gains in strength, which is not indicated by the high-alumina cements. The data furthermore show that the high portlands are high in early strength compared with the standard portlands of Table III, even if they are not high compared with the alumina cements.

Difficulties and Dangers—Unquestionably there are many cases in which the expedition of work will make the use of high-early-strength cements feasible and in the final analysis economical. But their use may be attended with some difficulties. These cements are quick-hardening, which means that they are reacting rapidly with the mixing water and indeed with the moisture in the air. Hence they will doubtlessly age rapidly on storage and may possibly get into work after they have lost some of their potential strength. Their rapid reaction may also result in pronounced volume changes at the early periods, and its rapidity suggests that the evolution of heat may be marked.

Their reaction may also be more seriously affected by too much water or impurities in the water than is the reaction in the case of standard portland cement. Furthermore, the reaction doubtlessly proceeds to a far greater degree than with the latter, and in later life the reaction products may be more deleteriously affected by atmospheric changes. The high-early-strength portland cements also tend to become quick-setting, and hence must be retarded with more gypsum than is used with normal portland cement; see the SO_3 determinations in Table II.

Practical and Laboratory Test—These are some of the uncertainties which must be settled, but data are not available—and unfortunately in the case of the high portland cements are not being obtained. But just as in the case of the development of the use of standard portland cement, which was very largely by actual trial and not as a result of investigation, the use of these new cements and how to use them will be largely a matter of actual job trial. It is unfortunate, nevertheless, that the producers of these new cements cannot see the value of obtaining critical data other than strength, particularly when it has been so well established that strength is not a criterion of the durability of normal cements in concrete.

TABLE II—ANALYSES AND TESTS OF SOME QUICK-HARDENING CEMENTS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cement Nos.															
Fineness, per cent residue on No. 200 sieve		20.0	9.0	1.7	12.5	6.9	(b) 0.7	(c) 3.1	(d) 2.6	11.5	8.2	10.1	4.3	7.3	12.2
Time of set (Gillmore), hours:minutes	Initial	4:15	2:15	2:45	3:15	3:00	3:10	4:10	4:40	2:55	2:45	4:00	1:45	2:45	5:00
	Final	7:00	5:05	6:45	4:45	5:00	6:20	6:35	7:35	4:35	7:15	6:00	3:30	4:45	7:30
Soundness		OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Strength, pounds per square inch:															
Mortar tests:															
1:3 standard sand mortars (parts by weight):															
Normal consistency (water per cent of dry material by weight)		10.2	10.2	11.5	10.3	10.3	10.0	11.5	10.8	10.3	10.7	10.6	10.2	10.3	10.
1-in. briquets (tension)	24 hour	100	205	285	185	210	260	276	265	185	205	145	265	450	310
	72 hour	260	320	325	285	315	385	360	400	285	305	270	350	400	285
	7 day	275	415	425	315	380	406	415	490	330	355	355	410	350	345
	28 day	365	460	485	425	440	390	450	515	380	415	470	470	415	400
2-in. cubes (compression)	24 hour	880	1,900	1,870	1,190	2,295	2,470	2,350	2,200	1,360	1,490	1,030	1,940	6,230	6,120
	72 hour	2,160	3,210	4,190	2,890	3,760	4,060	4,310	5,130	2,940	3,260	2,340	3,865	5,273	6,780
	7 day	3,240	4,195	5,450	3,340	5,100	4,550	5,000	6,340	4,080	4,300	3,750	5,380	5,533	6,700
	28 day	4,240	5,380	6,660	4,760	5,625	5,150	6,030	7,760	4,980	5,190	5,260	6,370	5,740	7,670
Concrete tests:															
1:2. 5:3. 5 (parts by volume):															
Water cement ratio (by volume)		1.04	1.03	1.16	1.10	1.04	1.08	1.08	1.08	1.04	1.16	1.08	1.04	1.00	0.80
6 x 12 in. cylinders (compression)	24 hour	340	215	395	255	670	945	1,050	1,035	180	375	435	335	3,300	(f) 4,470
	72 hour	730	825	1,340	1,080	1,600	2,010	2,460	2,470	870	1,190	1,220	1,505	3,650	(f) 5,210
	7 day	1,300	1,905	1,775	1,720	2,120	2,360	3,140	3,880	1,780	1,870	1,860	2,425	3,600	(f) 5,550
	28 day	2,200	3,030	2,960	2,610	2,990	3,030	3,960	4,530	3,520	2,970	3,450	3,310	3,140	(f) 5,580
Chemical analyses:							(e)						(a)		
SiO_2		17.75	19.87	20.65	20.80	20.23	19.70	20.3	21.7	20.75	20.27	22.1	22.97	5.45	5.36
Al_2O_3		7.95	6.83	6.60	7.10	6.79	5.40	5.5	5.1	6.40	5.43	6.1	4.19	35.76	35.87
Fe_2O_3		4.96	3.22	1.80	2.62	3.11	3.52	2.2	2.7	2.79	2.67	1.9	3.99	14.65	15.23
CaO		61.65	62.93	65.55	65.23	64.88	64.44	63.1	65.6	61.35	64.05	64.8	65.10	38.96	37.04
MgO		4.46	2.60	1.80	0.81	0.88	2.09	2.2	0.8	4.95	3.72	0.9	2.54	1.50	1.02
Cl		.....	.....	.....	.....	.....	0.45	.....	.....	.....	.....	.....	.....	.....	.....
TiO_2		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.93	1.94
SO_3		1.92	1.79	1.75	1.47	2.10	1.93	3.02	2.5	2.09	1.65	2.0	0.30	0.45	0.63
Ignition loss		1.80	2.19	2.20	2.33	2.04	2.14	3.2	1.6	1.06	2.60	2.0	.....	1.65	2.61
Insoluble		.....	.....	.....	.....	.....	.....	1.1	2.3	.....	.....	0.2	.....	3.82	3.74

(a) Analysis of clinker. (b) 97.8 per cent through 325 sieve. (c) 93.2 per cent through 325 sieve. (d) 93.9 per cent through 325 sieve. (e) Contains a fat acid soap as waterproofing agent. (f) Concrete proportions = 1:2:4. Cements 1, 2, 3 and 4 are foreign and 5, 6, 7 and 8 are domestic quick-hardening portland cements; 9, 10 and 11 are reported to be of good early strength but not sold particularly as quick hardening; 12 is a good standard portland received in clinker form and ground fine at the bureau; 13 and 14 are domestic high-alumina cements.

5—Standard Portland Cement

THERE can be no denying the fact that the rapid development and the present status of the cement and concrete industry is due largely to the existence of the single standard. It enabled the manufacturer to devote his efforts to the development of economical plant methods and business procedure, which in turn has resulted in a price for cement that is almost unbelievably low when the complexity of the process is realized. It also enabled the contractor to develop his procedure without too much thought of the quality of the essential ingredient of concrete, and to devote his time to studying the extension of the uses of concrete.

The User and the Single Standard—But eventually the time came when potential fields for new uses no longer existed and the contractor had time to think more of what he was making, how he was making it, and more especially what he had made. He was also being told that

he was not using cement properly, and that invariably any faults that his product had developed were due to his procedures and not to any inherent fault of the cement. This kind of argument inevitably directed his attention *to* and not *away from* the cement, with the result that he began to ask what standard portland cement was and how much individual brands varied from the hypothetical standard—not only in the laboratory but on the job.

In the meantime, a buyers' market having come into existence in the cement trade, the answer to these questions came from the cement industry itself. Competition led frequently to sales efforts through the alleged excellence of one brand over others. Those interested in the study of concrete also studied some of the various but also new requirements. These requirements have led on the one hand to the production of the new cement types previously discussed, and on the other hand to such additional requirements for standard portland as new limitations on the chemical composition, higher tensile strength, compressive mortar strengths, a maximum limit for the free lime and greater fineness of grinding.

Influence of Concrete Study—The attitude of the concrete industry toward the cement industry has come about very largely through the study of concrete. In many of these studies it was learned that, measured by strength alone, the quality of concrete could be increased or decreased very markedly solely through the choice of the cement, all other constituents of the concrete remaining the same. Hence, if concrete is specified by strength

TABLE III—ANALYSES AND TESTS OF TWELVE STANDARD PORTLAND CEMENTS

Cement Nos.		1	2	3	4	5	6	7	8	9	10	11	12
Fineness, per cent residue on No. 200 sieve		7.0	20.8	13.5	15.5	14.6	15.2	12.1	20.4	17.7	14.9	18.5	16.6
Normal consistency		26.0	23.5	25.8	22.5	24.2	22.5	24.5	21.8	22.0	23.4	21.2	22.9
Time of set (Vicat), hours : minutes	Initial	5:15	4:15	5:45	3:00	3:25	0:45	0:25	3:30	4:30	3:30	5:00	5:00
	Final	(a)	(a)	(a)	5:45	6:45	(a)	(a)	6:45	(a)	6:45	7:00	7:00
Soundness		OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Strength tests:													
1:3 standard sand briquets (tension)	7 day	305	210	240	290	235	250	275	295	270	245	220	290
	28 day	360	350	375	355	350	360	380	375	375	365	360	395
	1 year	420	330	320	350	310	350	415	320	345	395	475	345
1:3 2-in. cubes, standard sand (compression)	7 day	2,840	2,050	2,700	2,880	2,600	2,250	2,760	2,800	2,280	2,440	1,930	2,600
	28 day	4,420	3,480	4,360	4,070	4,050	4,100	4,260	5,050	3,790	3,780	3,610	4,500
	1 year	6,090	4,550	5,350	5,540	5,240	5,830	6,530	5,800	5,420	5,650	6,370	6,480
6 x 12 in. cylinders, 1:2.4:3.6 (by weight), water-cement ratio, 0.90	7 day	2,380	1,610	2,370	2,140	2,140	1,550	1,920	2,090	1,760	1,430	1,080	1,710
	28 day	3,860	2,660	3,920	3,500	3,340	2,830	3,170	3,540	3,380	2,400	2,440	3,370
	1 year	6,190	4,540	4,810	4,910	4,620	4,290	5,060	4,860	4,950	4,070	5,350	5,230
Chemical analyses:													
SiO_2		22.69	21.05	20.26	21.30	21.36	22.23	22.28	20.78	22.03	23.52	23.52	22.15
Fe_2O_3		4.43	2.53	3.47	2.34	2.07	2.34	4.73	2.67	2.30	1.95	3.72	3.49
Al_2O_3		3.51	5.92	5.49	7.18	5.92	6.11	3.95	6.73	5.76	4.71	5.28	4.28
CaO		65.03	60.25	64.03	61.68	61.60	61.43	63.25	62.77	62.42	63.82	62.06	62.18
MgO		0.66	5.67	3.19	2.74	4.91	4.01	1.80	2.77	3.14	2.25	1.25	3.91
SO_3		1.72	1.87	1.40	2.10	1.43	1.63	1.52	1.65	1.68	1.40	1.87	2.01
Ignition loss		1.65	2.03	1.54	2.50	1.72	1.56	1.63	1.80	1.88	1.84	1.60	1.37
Insoluble		0.18	0.12	0.16	0.85	0.22	0.29	0.37	0.22	0.86	0.12	0.06	0.16

(a) Final set more than 6½ hours, but less than 22 hours.

brands comparatively and found such wide differences at the usual test periods that they inevitably concluded that so far as strength was concerned standard portland cement in concrete might mean either one value or double that value.

Test Data—Some recent data obtained at the Bureau of Standards with twelve representative brands from different parts of the country are given in Table III. No comment is needed; the data clearly show how representative brands may differ from one another. Such a condition is not surprising, and must result from the proper development of any industry. Given the same raw materials, it may quite likely happen that through more efficient equipment and methods one plant will produce a better commodity than another plant. Given in one case a more knowing and efficient management, this likelihood is further increased.

The Line of Progress—The industry is in this stage at the present time. The next stage demands the interchange of knowledge and the application of the fundamentals of what cement should be and how it is to be obtained of similar quality from different raw materials. When this latter stage is reached, there will tend to result again a standard cement of more nearly uniform and more excellent quality. The coming of this stage will be accelerated by the tendency of the users to specify properties not now insisted upon. Of necessity producers will attempt to meet these individual demands and through such efforts will tend toward uniformity of product.

But before that stage arrives it is quite evident that we shall have an era of many and various specifications and resulting cements. In fact, we are in this era now, and have before us not only many different portland cements alone and not by the proportions of aggregate and cement or if a road can be put into service a few days or a week or two earlier solely through the choice of cement, it will surely follow that such a cement will be chosen as will give the desired strength when used in the least amount or at the earliest age. The resulting economies of the case will be the controlling feature, even to the possible paying of a premium for the more excellent cement.

Summary

THERE is no question that at the present time there is a decidedly unsettled condition in the cement industry. Collectively the industry seems well satisfied with standard cement. Individually it seems groping in the dark for something different, but whether better or not it does not seem to know. It seems most insistent that cement must be "stronger"; if not "stronger," then more "workable," or must possess some other equally intangible and at the present undefinable property.

Attitude of the Concrete Industry—The concrete industry individually and collectively feels a little more sure of itself. It has been told so often and so positively that it is to blame for all the faults that concrete may fall heir to and has failed to take proper advantage of the potential qualities of cement that it has ceased to be interested in this reiteration and has rather countered by asking the cement industry, *What is cement?* and *What happens when it comes in contact with water?*

Joint Interest in Research—These two attitudes are indicative of a stage in the development of two dependent industries. So far this development has been unusually rapid. But unfortunately these industries started before the present era in which new industries—as the automotive or the rayon—have made their even more

rapid development solely upon the basis of most intensive fundamental research. The cement and the concrete industries have been evolved largely through plant and process trial, or what might be called rule-of-thumb methods. Such development may be extremely rapid, but as such it is too much of mushroom type. To become truly stable with the scientific basis that it must have, research must be pursued, and at this time just as intensively as process development has been followed previously.

Cement Research Begun—Until but relatively recently the cement industry seemed intent only to investigate concrete, and the concrete industry seemed content to permit it to pursue its way. But having seen that to study concrete truly it must know cement, the former industry has turned its studies toward cement. This attitude is a collective one, however. The individual manufacturer in the great majority of cases has still to see the need of fundamental research of cement in his own laboratory.

Why Not Concrete Research?—More unfortunately still, the concrete industry has yet to see the need of either individual or collective study of that commodity, *concrete*, which is the means of its livelihood. It seems most deplorable that such huge industries as those engaged in making or dependent upon the making of concrete cannot through some central agency support vital research on problems in concrete to the extent of spending at least $100,000 per year. Should they spend such an amount, they would not be doing as much as the cement industry, and they should not be expected to do any less.

In conclusion, the major reason for the existence of plastic cement, slag cement, "super" cement, high-alumina cement, high-early-strength portland cement, white cement, waterproof cement, natural cement, etc., is the lack of knowledge of what a satisfactory hydraulic cement should be for any or all purposes, what qualities define and predict satisfactory service, and what methods should be applied for using cement satisfactorily for any purpose. The reason for this present lack is solely a too late realization of the need of fundamental co-ordinated research on the part of all industries interested.

Imperial Valley Silt Creates Problem in Drainage Ditch Maintenance

THE FINE silt deposited by the Colorado River in forming the rich soil of Imperial Valley has an occasional sandy stratum through which water percolates much more readily than through the well-compacted silt. Where drainage ditches cut through these pervious sand strata, if there is any considerable seepage, the banks will continually cave back as the almost vertical face of silt is undermined by seepage flowing from beneath it. These conditions make the banks continue to cave back and give much trouble in maintaining the drainage ditches.

As long as the drainage ditch is below the level of the pervious strata there is little that can be done to prevent the sloughing off of the steep silt faces. The use of sheet piling and cross-bracing has been tried, but often the thrust becomes too great to be resisted by any practicable construction. As long as seepage comes through the pervious strata the silt face above it will slowly but continually collapse into the seepage due to the impossibility of completely checking the undermining.

Where deep drainage ditches encounter this condition and the location of the ditch cannot be changed, the only practicable remedy thus far discovered is to retard the seepage by keeping the drainage water level above the pervious strata. The accompanying illustrations of one of the drainage ditches show how the silt faces keep getting farther and farther from the line where the caving began.

CLOSE-UP OF CAVING SILT BANK CAUSED BY UNDERMINING

This is typical of conditions frequently caused by drainage water seeping through a sand stratum and undermining the vertical silt face.

AN ENLARGED DRAIN THAT BEGAN AS A DITCH

Bank in foreground has continued to cave off until it is 100 ft. back from the line where caving began.

St. Louis Reconditions Old Sewers With Gunite

Sewers Dating Back to 1850 Are Relined—Flow Handled by Metal Flumes—Guniting Technique Important

By E. Paffrath
Assistant Sewer Commissioner, St. Louis, Mo.

TWO guniting crews of sixteen men each are constantly employed in reconditioning old St. Louis sewers. Some of these sewers were constructed as far back as 1850, of brick or of a combination of brick or stone. All of them are half a century old. By 1910, concern about further safety had been aroused and reconstruction was contemplated as a necessity. Then in 1915-16 surveys were made and various plans of restoration were tried out. Among these plans guniting appeared particularly successful. But there were no funds until 1923, when a bond issue was voted which provided $2,000,000 for reconditioning old sewers. This is the work that is now in progress.

General Construction Plan—Restudy of the various repair methods with which the department had experience led to the conclusion that relining with gunite would in general put the sewers in sound condition and that actual reconstruction of the surface would be necessary in only a few instances. The work was therefore organized to include two main operations: (1) relining the sides and arches with gunite; and (2) reconstructing the inverts with concrete covered with brick or tile. As

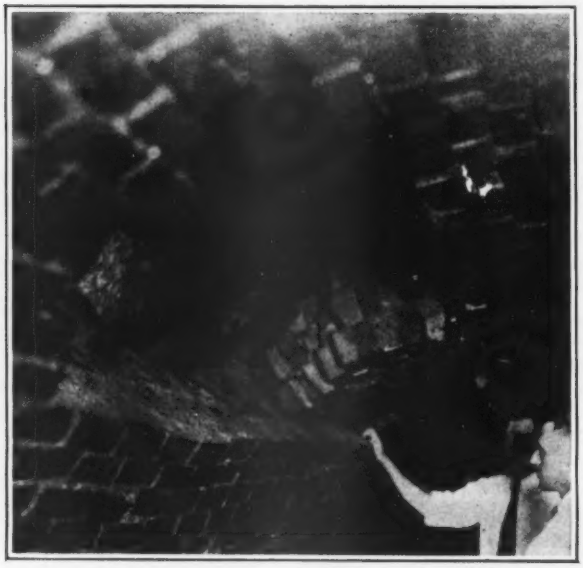


FIG. 1—TYPICAL CASE OF DISINTEGRATING SEWER ARCH
This sewer had been laid with a weak mortar. Many of the others had practically no mortar in the joints.

this work must be carried out without putting the sewers out of service and the quantities of materials to be used could not even roughly be estimated in advance, it was not considered advisable to attempt to carry it out by contract, and a special force was organized under the assistant sewer commissioner.

Shaft Construction—Normally shafts are sunk to the sewer about 300 ft. apart along the street. These shafts are 5x8 ft., timbered, and are located so that one of the sides is in line with the side of the sewer. In some cases manholes are finally constructed in these shafts, but ordinarily they are closed and back-filled. In general only three shafts are open at the same time. Only in summer, when considerable hot water is being discharged into the sewer, is it necessary to have more shafts open or to space them closer. In one case nine shafts, 150 ft. apart, were required.

Flumes Bypass Sewage—Fluming the sewage was one of the first problems considered. A common practice had been to construct wooden flumes. This method was soon found to be impracticable on account of the great loss of time and material which always resulted during a rainstorm. As a result of this experience there has been adopted what is called the sack flume. This is used on

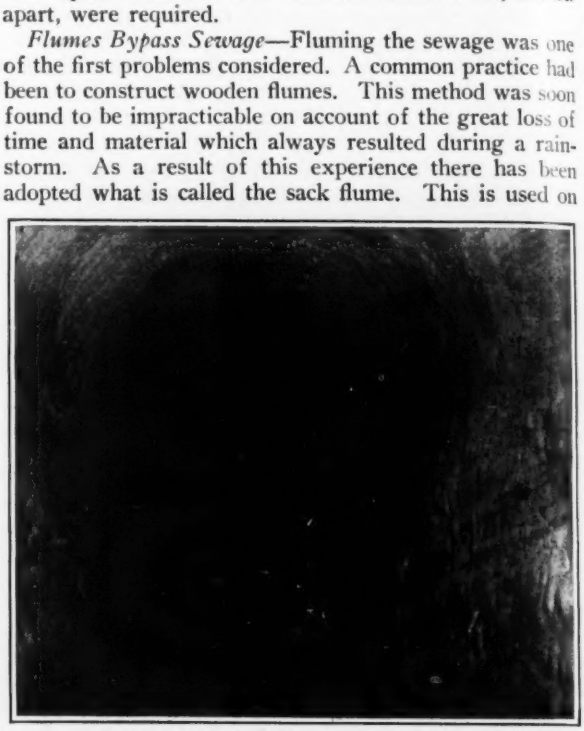


FIG. 2—TYPICAL LARGE SEWER WITH LIMESTONE WALLS AND BRICK ARCH
Guniting partly completed; note the appearance of the relined walls.

the larger sewers having flat bottoms. Instead of reconstructing the bottom all the way across the sewer, it is found best to construct it to half width, with the sack flume forcing the water over to the other half. When the other section of the bottom is constructed, this operation is reversed. The result of this change has been the saving of thousands of dollars in lumber and carpenters' time. Sack fluming requires only ordinary construction labor.

As an example, the first sewer that was reconstructed in St. Louis during the present program was a 12x12-ft. sewer with a rough rock bottom, rock side walls and a brick arch. When this work was first started a rainy period prevailed, with the result that nearly 20,000 ft. b.m. of lumber and considerable labor-time were consumed before any real results were accomplished. Each time a flume was installed and properly braced—in fact, exceptionally heavily braced—the water would tear it to pieces and float it down the river. About 100 ft. of flume in this sewer required about 3,000 ft. b.m. of lumber and about five days to construct, with one carpenter and six laborers. To install this sack flume required about six laborers less than half a day.

Another type of sewage bypass which has to be adopted at times is a metal flume. This is made of heavy sheet-iron pipes, usually 12 in. and 18 in. in diameter and 10 ft. long, with a flange joint on each end so that they can be bolted together for any desired length.

The number of lines of pipe depends, of course, upon the dry-weather flow. Two and sometimes three lines of pipe are used in the large sewers. It is necessary to construct a heavy sack dam, reinforced with timber on the downward side. This dam forces the water through the pipe and exposes the entire bottom over which the flume reaches. These pipe flumes are anchored to 12-in. boat spikes driven into the side of the sewer before guniting. After the arch and the side walls are gunited the flumes are installed and secured to the spikes.

Guniting Procedure—Before applying gunite it is necessary to clean the surface to which it is to be applied. When loose mortar is found in the joints, it is thoroughly raked out and the surface is sandblasted. Sandblasting is not always necessary; this depends entirely upon the condition of the sewer. If the surface has a greasy or oily coating, it will require sandblasting; if this is not the case, a 2½-in. fire hose is used to wash it down thoroughly. It has been found that not all sewers have this oily coating, but some merely a coating of what appears to be a loam or earthy substance, which can be removed with a fire hose. Shortly after gunite is applied the surface is broomed, which gives it a smoother finish.

It sometimes becomes necessary to reinforce a part of the arch. Steel wire mesh is fastened in place to the proper elevation. The arch is then shot with gunite until it has been built out to the original surface. This takes considerable time, as only thin layers of gunite can be applied; if it is applied in thick layers it will fall off, as there is no form or support to hold it in place.

From time to time a sample of the gunite work about 1 ft. square and about two courses of brick in thickness

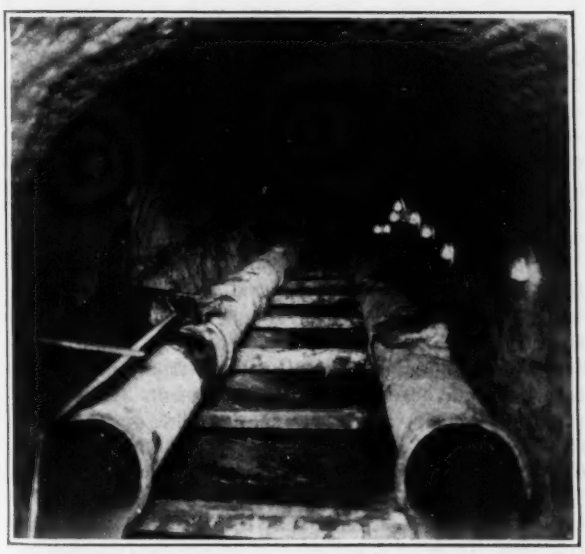


FIG. 3—TYPICAL CASE OF FLUMING WITH METAL PIPES
Guniting of the arch is completed, and restoration of invert is in progress.

is cut out of the side of the sewer. An examination of these samples shows whether the joints have been filled and whether the surface of the old masonry has been cleaned so as to insure a proper bond.

Lessons of Experience—The accompanying table is given as an example of the cost of the work described. Here the cost of guniting has been kept separate from the reconstruction of sewer bottom. In this particular instance the bottom was reconstructed by removing old rock, placing new concrete lining on smooth grade and covering this with flat tile liner blocks. It will be noted that the costs given are for labor and material only and do not include interest, depreciation on equipment, power or general overhead.

One of the important things learned through experience is the amount of air pressure to be used. It has been found that this pressure must from time to time be increased or reduced, depending entirely upon the work that is being done. It has been found that the distance from the end of the nozzle to the actual surface of the work has a great deal to do with the amount of air to be used. If the air pressure is too strong, the result is an excess rebound of material. If not enough air is used,

COST DATA ON SEWER GUNITING, ST. LOUIS, MO.

Item	Unit Sq. Ft.	Unit Labor Cost	Unit Material Cost	Unit Cost Total
Guniting	11,556	$0.056	$0.042	$0.098
Sandblasting	11,556	0.02	0.002	0.022
Scraping joints	11,556	0.022	None	0.022
Guniting (complete)	11,556	$0.098	$0.044	$0.142
Concreting bottom	1,200	0.281	0.248	0.529
Liners in place	1,200	0.127	0.269	0.396
Bottom complete	1,200	$0.408	$0.517	$0.925

a more porous mortar results and small crevices are not properly filled.

The materials are as important as the air pressure, for both must be properly proportioned to produce the desired results. The result of experience has been that an automatic hand drier has been constructed having a capacity of 12 cu.yd. a day. Weather conditions determine to a great extent the condition of the sand for guniting. Sand as delivered is always more or less damp, especially during a rainy season or where work is done when the atmosphere is damp. In real damp weather dry sand is used altogether—that is, sand coming from the sand drier. Then again 50 per cent dry sand and 50 per cent stock sand have been used. However, this percentage varies, and the proper proportion of the sand mixture can be determined only from experience.

All cement should be sifted before it is placed in the concrete mixer, so that lumps due to dampness, etc., may be removed. If these lumps pass into the cement gun and into the material hose, they will plug it up and cause considerable delay. Also, if too damp a sand is used the same trouble is encountered.

In connection with the guniting outfit it has been found advisable to use an air drier as an additional aid in keeping the material in proper condition. Much work is washed out by rains. This loss can be greatly reduced by the use of quick-setting cements during a period of doubtful weather.

There are several preparations on the market that can be used in connection with ordinary portland cement to protect freshly gunited surfaces against washing out two hours after their application. However, the constant use of these preparations is not recommended, as gunite is at its best when applied without them.

Canadian City Over 90 Per Cent Metered

The water supply of Regina, Saskatchewan, is over 90 per cent metered. Bills are rendered monthly, readings being on the continuous plan. Meters of both the light and power department have been read and billed together for five or six years at a saving to both departments, and to the convenience of citizens. J. W. D. Farrell is superintendent of water-works.

Educating Engineers in Economics

A New Type of Engineering Training Is Rapidly Becoming Indispensable—Changes Necessary to Maintain the Prestige of Engineering

By W. E. Wickenden
Director of Investigation,
Society for the Promotion of Engineering Education

The following is an abstract of an address delivered by Mr. Wickenden May 26 before the Industrial Conference at Pennsylvania State College.

ENGINEERING is an art, and only incidentally a science. The engineer is called upon to meet and handle constructively a succession of concrete situations. The original engineer was a builder; his task was to create a structure or a machine that would do some job safely and effectively, with only incidental regard to economic theory or to refinements of scientific technique. As the resources of science and engineering construction increased, it became his job not merely to design and build but to choose between alternative methods on the basis of costs and values. With the increasing complexity of industry and public works, engineering effort expanded from the realm of machines and structures into the realm of co-ordinated plants and systems. In still more recent years the subdivision of labor incidental to the growing complexity of industrial processes reached a level where it was no longer possible to separate human skills from technical processes, and the engineer began to work with men, as well as with materials and dollars.

The Engineer and the Business Man—It would be an error, however, to assume that this evolutionary process has made the engineer indistinguishable from the business man. Their functions are closely related, but essentially complementary. The ultimate aim of both is to serve society, but their immediate aims are usually quite unlike. The engineer aims at economy of construction, production and utilization; the business man aims at profit from finance, risk bearing and distribution. The engineer is disposed to stress savings and conservation, whereas the business man stresses promotion and exploitation. The engineer aims to reduce all uncertainties to a minimum before risking a decision and seeks, as far as possible, to be right in every case. His is one of the few professions that are expected to guarantee results. The engineer's methods are more deliberate than those of the business man, who finds himself called upon to make quick decisions on intuitive or impressionistic grounds and who is expected to be right in his judgments in only a reasonable margin of cases. The engineer has at his service the whole range of objective science and he partakes not a little of the temper of the man of science. There is still a wide gap between business and what is hopefully called economic science.

The lay public seems to have ample confidence in the engineer as a technologist. No one outside of engineering circles seems much concerned about strengthening engineering on the technical side. What people are wondering is how large a place of leadership the engineer is going to claim in society and how competent he is to hold it.

Without judging the success of modern collegiate education for business, it seems to be a perfectly safe observation that it has not solved the problems of economic training for the engineer. Merely to displace a considerable quota of physical science and technology in the engineering curriculum with selections from the special subjects of the business curriculum does not solve the problem. It may produce a useful hybrid, a cross between the engineer and business man, but it does not seem to produce actual engineers.

Society at large must conserve its material capital if it is to survive, and the engineering profession is society's custodian of natural resources, responsible for promoting long-range economy as a check to wasteful exploitation for the sake of quick profit. These are the real premises of all engineering effort, but they receive scant and merely incidental emphasis in our formal engineering education, which is largely preoccupied with the mastery of scientific tools and technical arts. Command of these tools and arts, while wholly indispensable, is essentially a means rather than an end. Is the perspective of engineering education what it should be?

Without judging the success of modern collegiate education for business, it seems to be a perfectly safe observation that it has not solved the problems of economic training for the engineer. Merely to displace a considerable quota of physical science and technology in the engineering curriculum with selections from the special subjects of the business curriculum does not solve the problem.

Education for Engineering and for Business—It is fitting that engineering education and business education, while complementary in aim, should be largely distinct in their content and method during the foundation period. Engineering education has developed from the physical sciences, while business education represents a less mature attempt to develop a professional discipline out of applied economics. The materials of one curriculum are capable of assimilation into the other to a limited degree only.

Engineering education necessarily begins with the mathematical and physical sciences and with verbal and graphical forms of language. It progresses through the mechanics of matter, motion, elasticity and energy to a synthesis of the principles which enter into the design, construction and functioning of tools, machines, structures and plants. By its nature it emphasizes highly principles which are capable of objective verification, relations of a quantitative nature and problems of an analytical type. Its materials lend themselves to fairly rigorous, logical processes of teaching. However much it may be enriched by studies of a humanistic type—and these are indispensable for a balanced result—its principal emphasis remains, for better or worse, physical, quantitative and analytical. It is essential that the engineering student should build up a sound economic philosophy and

gain some acquaintance with the economic functioning of society. If possible, he should have some historical perspective as well as knowledge of the present-day cross-section, but the crux of the problem is to make his economic training functional. It must be interwoven with his technological training so that criteria of economy for the solution of engineering problems may be perceived and the technique of economic analysis may be built up concurrently with the technique of physical analysis. If this view is correct, a solution must be sought by methods distinctive to engineering education. It cannot be accomplished solely by amplifying instruction in formal economics nor by direct borrowing from the realm of business education.

The existing curricula in industrial engineering have been a useful and probably a necessary expedient, but they do not afford an adequate solution of the problem. A broader plan, extending through all the major divisions of engineering curricula, seems to be needed, but the succesful inception of such a plan involves many difficulties, chief among which are the recruiting of an effective teaching force and the assembly of satisfactory teaching materials.

General Economics—The engineer has the same need for an understanding of economics in its broader sense as any other man who exercises a directing influence in society. The lay public seems to have ample confidence in the engineer as a technologist. No one outside of engineering circles seems much concerned about strengthening engineering on the technical side. What people are wondering is how large a place of leadership the engineer is going to claim in society and how competent he is to hold it.

Not many economists have become public leaders. When one observes how thrilling the living problems of economy are and how arid economic doctrines become in formal treatises, one wonders if there is not a better way to approach the subject. It is not surprising to find a revolutionary party among economists, a group of "young Turks" as it were, who are trying to find some more realistic way of introducing the subject. The engineering student, the despair of many academicians, has a reputation for being ultra-realistic. One of these insurgent economists stated to the writer that if he could find the right way to present economics to engineering students it would be, *ipso facto,* the right way for every one else. What these insurgents are reaching after is a more inductive approach to the subject.

"Take three or four sizable divisions of industry," they say; "for example, rail transportation, the manufacture of automobiles and the extraction of oil; show what their economic aims are, how they are set up to accomplish them and what criteria can be applied to measure their efficiency. After giving the students some notion of how the economic wheels are geared together and go around, work up to the general principles of the subject." When doctors disagree, who shall decide? In any case, whether we cling to classical economics or follow the insurgent party, much might be gained by assembling and making available a body of illustrations and problems from engineering and industrial activity.

Economic Organization—It may be doubted whether any detailed study of organization technique, as used by the business executive, belongs in the undergraduate engineering curriculum. The engineer needs to be familiar with the functional structure of economic society in general and of one or more of its major divisions in particular. The divisions of primary importance are the extracting and refining of minerals, the preparation of basic chemicals, manufacturing, transportation, power and fuel supply, communication and public works; while finance, risk bearing and distribution take a secondary level of importance. As no student can afford time to cover this wide area thoroughly, a general survey of the whole and a more intensive study of one of the divisions would probably be as much as could be attempted. There is a need of materials of instruction primarily designed for students of engineering, with a realistic and dynamic type of treatment.

Engineering Economy—Wellington's classic "The Economics of Railway Location" stands fairly alone as a systematic treatise of engineering economy. In other engineering fields good educational material is both meager and scattered. While one or two existing books and one or more others now in preparation attempt to present the principles and problems of engineering economy in generalized form, it is not certain that this method will prove effective. An inductive method, based on case materials applicable to all divisions and all stages of engineering instruction, and suitable for use by the present teachers in the regular technological subjects, seems much more promising. It would be difficult for any individual to collect and prepare a representative body of case material. Much of the best of it is in the records of corporations and consulting engineers, who might be willing to make it available to the engineering colleges through some common service channel but who would demur at the invitation to open it up as a field of individual enterprise for the textbook writers. Here is indicated a suitable service function for the Society for the Promotion of Engineering Education.

Functional Branches of Engineering Curricula—The problem of devising an educational scheme which is simple enough to be economical, which keeps within the limits of the student's advance knowledge of his career and which at the same time fairly covers the whole range of engineering functions and activities is ever with us. The constantly expanding area of the profession tends to leave a considerable area outside the educational scheme. Clearly, it is a great advantage to keep this educational scheme closely parallel to the plan of organization of the profession. How otherwise can we hope to get the professional body to aid in the conduct and nurture of education without cross-purposes? The historic technical divisions of the engineering profession bid fair to persist as the primary lines of cleavage for a long time. There

The difficulties should not deter us from a vigorous attack upon the problem, nor should we allow an excess of educational realism to tempt us to dismiss the whole matter on the ground that the problems of engineering economy and management are unteachable. If our educational program makes no adequate provision for the development of these fields, we shall certainly expect to see them pass into non-engineering hands.

is little prospect that a major branch will arise which is based on engineering economy and administration, apart from engineering technology. Subdivision of curricula for undergraduates along technical lines has already gone as far as is prudent and, in some cases, possibly farther. The next step should probably follow functional lines of subdivision within the major technical divisions of curriculum.

In an earlier section it was pointed out that the engineer began as a constructor, developed into a practical economist, then into an organizer of human effort, and now emerges as an executive. These elements appear in varying proportions in the work of all engineers and do not afford a clear basis for occupational classification. A more promising classification for educational purposes is that between (1) originating new structures, machines, installations and processes; (2) operating going installations and services. This classification can be applied to all major branches of the engineering profession. The civil engineer, for example, originates structures, highways, railroad lines, hydraulic developments, municipal facilities and the like; he operates transportation systems, water-supply systems, waste-disposal systems, traffic systems, navigation facilities, and the like.

The present curricula in engineering are largely based on the older "originating" function. The newer "operating" function is recognized only in segregated curricula known as industrial engineering, engineering administration, and the like, which enroll a small but increasing proportion of the total body of students. It is clear that the demand for men to begin engineering careers in minor technological activities is large and growing. There is a fairly stable demand for men to advance from this starting plane to the higher levels of creative technology. There is an increasing demand for men to advance to higher responsibilities on the operating side. In the aggregate, the amount of new creative engineering work is relatively constant, but the work of operating is cumulative as new installations are made and old ones expanded. It is a reasonable expectation that half or more of the student body would choose an optional program on the operating side of engineering rather than on the originating side, provided the prestige of the two options, the qualifications of the teachers, the vigor of the teaching and the excellence of the materials of instruction were equal.

The existing curricula in industrial engineering have been a useful and probably a necessary expedient, but they do not afford an adequate solution of the problem. A broader plan, extending through all the major divisions of engineering curricula, seems to be needed, but the successful inception of such a plan involves many difficulties, chief among which are the recruiting of an effective teaching force and the assembly of satisfactory teaching materials. We must be on our guard not to substitute the incidental mechanics of management for the basic principles of engineering. These difficulties should not deter us from a vigorous attack upon the problem, nor should we allow an excess of educational realism to tempt us to dismiss the whole matter on the ground that the problems of engineering economy and management are unteachable. If our educational program makes no adequate provision for the development of these fields, we shall certainly expect to see them pass into non-engineering hands.

Recent Earthquake Effects in Greece

A LETTER just received from an American engineer now in Greece gives some interesting facts on the recent earthquakes in that country and their effects. The most interesting parts of the letter follow:

We have been having severe earthquakes here, and yesterday (April 28) I had opportunity to look over the territory near Cornith, where there was a considerable amount of destruction. The damage was done principally by two of the many shocks, both of which happened at night. Deluges of rain and hail and violent winds preceded. Most of the 15,000 people were alarmed by the first shock and ran out of their houses, so that the death list was small.

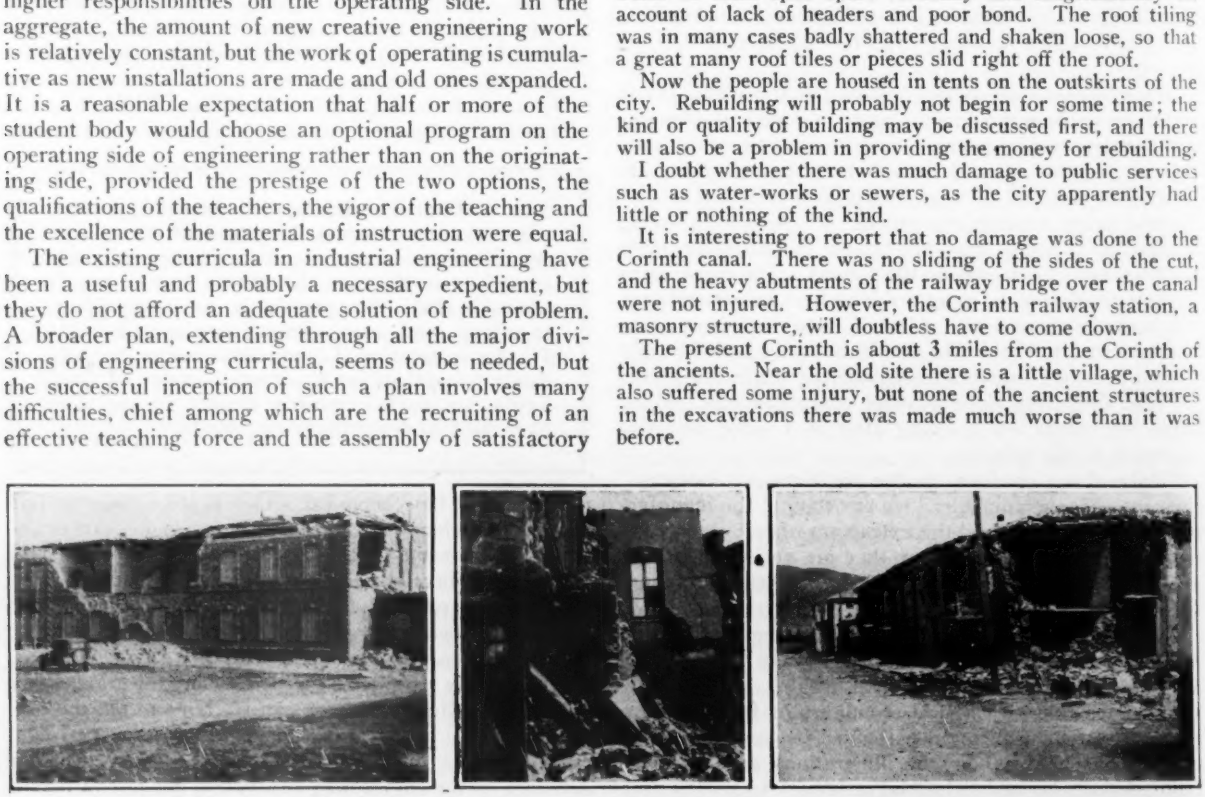
It looks as though every house in town should be torn down and the city built anew. Practically no building escaped damage. The poorer ones collapsed, while the better ones were cracked and knocked out of plumb and their interiors pretty well wrecked. The houses generally have masonry walls, and gable roofs boarded over and covered with a poor quality of tiling. The walls, usually 20 in. thick, consist of a facing of poor limestone and a backing or interior of spalls, bonded by lime-mortar in the better buildings and a mixture of lime and mud (or even mud alone) in the poorer ones. Some of them split apart vertically and longitudinally on account of lack of headers and poor bond. The roof tiling was in many cases badly shattered and shaken loose, so that a great many roof tiles or pieces slid right off the roof.

Now the people are housed in tents on the outskirts of the city. Rebuilding will probably not begin for some time; the kind or quality of building may be discussed first, and there will also be a problem in providing the money for rebuilding.

I doubt whether there was much damage to public services such as water-works or sewers, as the city apparently had little or nothing of the kind.

It is interesting to report that no damage was done to the Corinth canal. There was no sliding of the sides of the cut, and the heavy abutments of the railway bridge over the canal were not injured. However, the Corinth railway station, a masonry structure, will doubtless have to come down.

The present Corinth is about 3 miles from the Corinth of the ancients. Near the old site there is a little village, which also suffered some injury, but none of the ancient structures in the excavations there was made much worse than it was before.



TYPICAL INSTANCES OF WALL AND ROOF DAMAGE IN RECENT EARTHQUAKE IN GREECE

A.A.E. Annual Meeting Held at El Paso

Mexican Engineers Are Guests—Next Meeting at Mexico City—Finances Improved—Resolutions Adopted

A SPIRIT of harmony and an earnest desire to work for the improvement of engineering conditions were the keynote of the fourteenth annual convention of the American Association of Engineers, held at El Paso, Tex., June 4 to 6. More than 100 members of the association were in attendance. An international flavor was given to the meeting by the attendance of 100 delegates from the Centro Nacional de Ingenieros, of Mexico, in response to an invitation given some time ago to Mexican engineers to change the date of their convention from September to June, and the city from Mexico to Juarez, so that they might take part in the meeting of the A.A.E. The result of this experiment was such a success that the A.A.E. has been invited by the Centro Nacional de Ingenieros and the Mexican government to hold its convention next year in Mexico City. The invitation was unanimously accepted.

Honorary life membership in the A.A.E. was conferred upon Leopoldo Vasquez, president of the Mexican association.

The financial affairs of the association are in better condition than ever before. Not only is there no outstanding debt but the permanent fund recently started to provide for a possible future home for the association has reached the sum of $15,000 and is steadily growing.

Reports were presented by a number of committees on work done in the advancement of engineering during the past year. Paul Hansen, chairman of the committee on services and fees of practicing engineers, submitted the manuscript for a pamphlet to be published by the association for the guidance of engineers and those who use their services. Sections of the pamphlet are entitled: "How to Employ and Use Services of Practicing Engineers," "Fees and Professional Agreements," "Minimum Recommended Fees" and "Code of Practice." It is expected that this book will be ready for distribution by Sept. 1. V. Bernard Siems, chairman of the committee on taxation and public improvements, reported on the efforts of that committee to outline a model plan by means of which adherence to economic and comprehensive programs of local public improvements might be obtained. The committee recommended further study by sub-committees on the six major features of taxation, budget system, city development and planning, finance, civil service, and public relations.

The policy of fighting fake correspondence and trade schools, which has been followed by the association for more than a year, was unanimously approved and will be continued. The recommendation of the permanent fund committee that a welfare foundation, to take care of needy engineers who are unable to support themselves because of old age, accidents or other causes should be started immediately was approved. The committee on relations with engineers in foreign lands presented an interesting report outlining its accomplishments to date.

Wallace R. Harris, of Milwaukee, Wis., was elected president of the association, and M. E. McIver was re-elected secretary. Among the speakers at the convention were Brent N. Rickard, manager of the El Paso smelter of the American Smelting & Refining Company, whose subject was "Copper Smelting"; Augustin de los Cobos, of the Centro Nacional de Ingenieros; Angel Permbert, professor of the School of Mines at Mexico City, and R. C. Waggoner, assistant to the chief engineer, Texas & Pacific Railroad, whose subject was "What the Railroads Need."

The convention passed a number of resolutions setting forth its views upon national questions and engineering problems. The appointment of C. W. Sturtevant to the Mississippi Flood-Control Commission was vigorously approved. The convention indorsed legislation by the various states to the end that long-drawn-out litigation might be avoided by arbitration of legal disputes of a highly technical nature and disputes growing out of construction and breach of contracts, damages and similar engineering difficulties. A definite and sustained reforestation program and the wide utilization of our present timber resources were advocated.

It was recommended that the classification of professional engineer, used by the U. S. Census, should be subdivided into more specific terms, thus increasing the value of statistics obtained from the next census. The national board of directors of the association was authorized and directed to seek ways and means for uniting the A.A.E. with other organizations of licensed, registered or professional engineers. Laxity in the enforcement of laws for the registration of engineers was condemned, and a committee was appointed to consider means of better enforcement of such laws.

A telegram was received from Herbert Hoover, Secretary of Commerce, congratulating the association on its work in advancing the standing of engineers as a group. The message was acknowledged by a resolution of thanks which will be forwarded to Secretary Hoover.

Report Made by Inland Waterways Corporation

During the calendar year 1927 the Inland Waterways Corporation transported 1,650,207 tons of freight on its various divisions and sustained a net loss of $179,423, according to the official report submitted by Major Gen. T. Q. Ashburn, chairman and executive officer. He estimates that the operations of the corporation saved the general public the sum of $2,302,000 during this same period.

The Inland Waterways Corporation was established by Congress for the purpose of "carrying on the operation of the government-owned inland, canal and coastwise waterways system to the point where the system can be transferred to private operations to the best advantage of the government." Three barge lines and a terminal railway are at present in operation: the upper Mississippi division, between the twin cities of Minnesota and St. Louis; the lower Mississippi division, between St. Louis and New Orleans; and the Warrior division, extending from New Orleans to Birmingport, Ala., through the Industrial Canal, the Mississippi Sound and the Warrior River. The fourth property, the Warrior River Terminal Company, operates a 19-mile terminal railway extending from Birmingport to Ensley, Ala., at which point it connects with a number of main-line railroads.

The capital stock of the corporation, all of which is owned by the United States, has recently been increased from $5,000,000 to $15,000,000 by an act of Congress, approved by President Coolidge. This additional capital will make possible a program of expansion which will greatly increase the amount of freight handled.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Gage Boards Guide Motorists When Highway Is Flooded

BETWEEN Mansfield and Wooster, Ohio, there is a stretch of road which is frequently under water due to overflows from a branch of the Jerome River. At such times motorists often drive through, unless the

GAGE BOARDS SHOW WATER DEPTH IN FLOOD TIMES

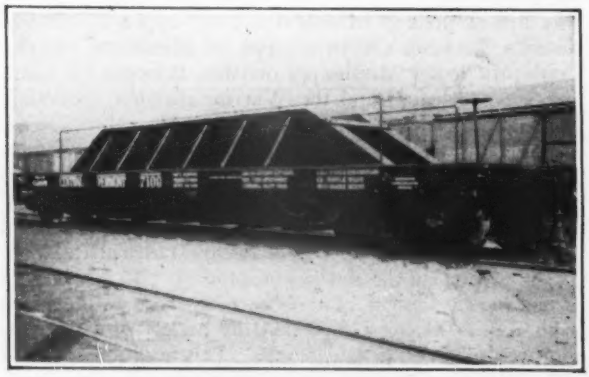
depth is too great. In order to guide the drivers and at the same time give them accurate knowledge of the depth of water ahead, T. S. Brindle, division engineer, has had gage boards erected at short intervals along each edge of the road.

This information was obtained from the National Paving Brick Association.

Railroad Car of Special Design Hauls Huge Stone Slabs

By W. C. Hamm
Mechanical Engineer, Central Vermont Railway Company, St. Albans, Vt.

THE Central Vermont Railway Company has built a special car to transport the occasional massive single stones that are produced by the Vermont granite quarries



CAR FOR HAULING LARGE STONE SLABS

and cannot be shipped on a standard car. This car, of 50 tons capacity, is of the well type, and will carry a stone slab 22 ft. long, 3 ft. thick, 15 ft. 8 in. wide and still keep within the American Railway Association standard vertical clearances.

As seen from the accompanying illustration, the center sills are incorporated in two 5-ft. 8-in. plate girders. The girders are stiffened by six gusset plates on the outside of each girder which take all side thrust. Due to the wide spacing of the center sills, they are extended through to the end sill and are connected to the draft and side walls by heavy body-bolster and cover-plate construction. Channel-iron crossties at the bottom of the girders carry the load. Timber stringers at the bottom and sides block the stone in place as well as protect it from the steel members.

The car was designed and built at the St. Albans, Vt., shops of the Central Vermont Railway Company.

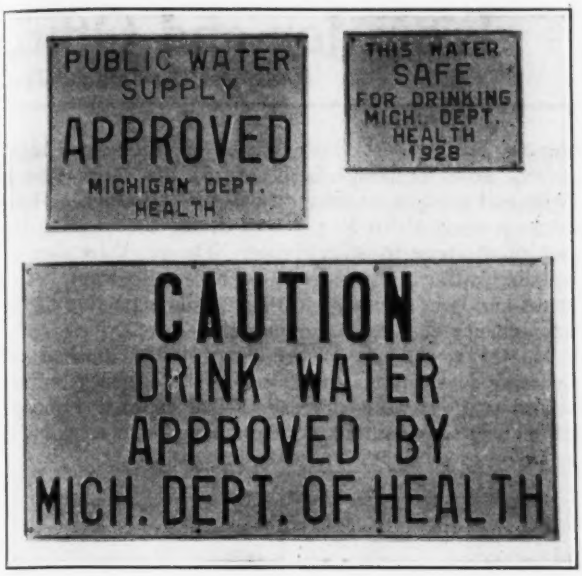
Safe-Water Signs in Michigan

IN THE inspection of roadside water supplies by the Michigan State Department of Health, the three signs shown in the accompanying illustration are used. The safe-water signs, as modified last year, were shorter than those for previous years and thus could be handled more readily and were less likely to be bent out of place.

The smallest, or "safe," sign, 7½x9 in., is for posting at an individual supply, either by attaching it to the pump with wires or by fastening it to a building or other convenient support. The "approved" sign, 10x13 in., is for municipal supplies and was used for the first time in 1927. It was attached to the municipal limits signs erected by the State Highway Department on the trunkline roads. As city officials often neglected to put up these signs when they were given to them, the Health Department will put them up in the future. None of the large "caution" signs, 14x27 in., was erected last year, but this year it is expected to put up about 200 along the roads out in the country and well away from advertising signs. Their use is considered advisable in order to warn people of miscellaneous drinking places, particularly those that have not been approved by the department.

As to the "safe" signs, it is pointed out in the annual report of Edward D. Rich, director of the bureau of engineering, Michigan Department of Health, that while it is not convenient to have a sign on an individual supply made large enough to attract attention from automobiles at a distance, yet it should be sufficiently conspicuous to be seen by persons near the drinking place. For this purpose rather striking colors are desirable, and the most satisfactory combination has been black letters on an orange background, as used in 1927. This is used year after year on the two larger sizes, but is varied on the smallest sign in order to have a slight contrast for different years. For 1928 this sign has a lighter yellow background than for 1927.

During 1927 two engineers with motor cars collected

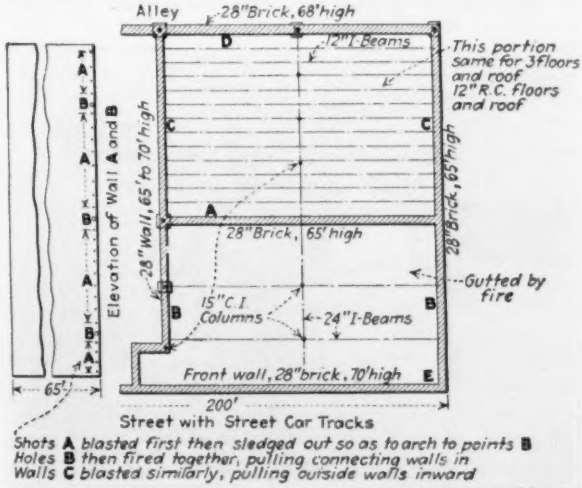

PUBLIC WATER SUPPLY
APPROVED
MICHIGAN DEPT. HEALTH
THIS WATER SAFE FOR DRINKING MICH. DEPT. HEALTH 1928
CAUTION
DRINK WATER APPROVED BY MICH. DEPT. OF HEALTH

ROADSIDE WATER SIGNS IN MICHIGAN

and forwarded samples of water from roadside supplies, thus covering the ground more rapidly than by the former method of having two men with one car. The survey covered 7,190 miles of trunk highways and the taking of 1,212 water samples. Of 1,196 sources tested, 83.6 per cent were found safe and 16.4 per cent unsafe, which was a marked improvement upon the condition in the two previous years.

Safe Wrecking of Brick and Concrete Building by Blasting

BLASTING down a building of which fire had left standing several 65- to 70-ft. brick walls and a three-story portion of brick walls and I-beam concrete floors so as to drop virtually all of the wreckage within the building area was accomplished recently at Scottdale, Pa. The plan and structure of the building are indicated by the illustration herewith. The masonry of the walls was hard set and the walls were all well bonded together. They were seven bricks thick, with a 2-in. air space between the fourth and fifth layers of brick and a 6-in. air space in the pilasters. These air spaces were bonded across by soldier courses about every seven courses.


Alley
28"Brick, 68'high
12"I-Beams
This portion same for 3floors and roof 12"R.C. Floors and roof
28"Brick, 65'high
28"Wall, 65' to 70'high
Elevation of Wall A and B
28"Brick, 65' high
Gutted by fire
15"C.I. Columns
24"I-Beams
Front wall, 28"brick, 70'high
65'
200'
Street with Street Car Tracks
Shots A blasted first then sledged out so as to arch to points B
Holes B then fired together, pulling connecting walls in
Walls C blasted similarly, pulling outside walls inward

PLAN OF BUILDING BLASTED AFTER INTERIOR HAD BEEN DESTROYED BY FIRE

Because of the wall structure the shots had to be placed on both sides. It was figured also that the wall would arch itself on about a 45-deg. angle. Therefore it was decided to take down first walls *B* by blasting as indicated by the accompanying sketch. Holes *A* were drilled 18 in. apart on both sides, and were blasted two to four at a time with ⅓- to ½-stick charges of dynamite. This blasting took out the arches shown by the dotted lines. The walls *B* then stood on a series of piers *B*. The charges in all of these were then fired together, dropping the walls vertically and pulling inward in their fall the front wall. Wall *A* was taken down similarly but broke off between the first and second floors. Next walls *C* were blasted in the same way as walls *B* and in falling dropped the floors and pulled inward wall *D*.

All the drilling was done before any of the blasting started, and in places where the pilasters or the supporting portions of the wall held after the shooting they were blown out by mud caps. All of the brick fell on the lot with the exception of a portion marked *E*, consisting of approximately 10,000 bricks, which, due to a crevice in the wall, collapsed one-half out upon the street. The building was completely razed at a cost of less than $500 and salvaged for the owners more than a million bricks and several tons of structural steel. For the completion of the work it was necessary to use 65 lb. Atlas L. F. extra 40 per cent dynamite and approximately 200 Atlas No. 6 electric blasting caps. The work was done by Frank S. Sloan, blasting constructor.

Novel Method for Operating Pump Controls by Main Pressure

By Franklin Henshaw
Superintendent, Water Department,
Scarsdale, N. Y.

THE Scarsdale pumping station is located about ¼ mile from the standpipe, and as originally designed, the automatic control gages were placed in a chamber under the standpipe and operated through an electric cable. Condensation of moisture in this chamber caused much trouble and the system could not be depended upon. Short circuits caused by moisture frequently caused the standpipe to overflow. Although laying a small pipe beside the force main, thus giving a constant static pressure at the gages which would be located in the pumping station, was considered, the following arrangement and apparatus were finally adopted to secure satisfactory automatic operation:

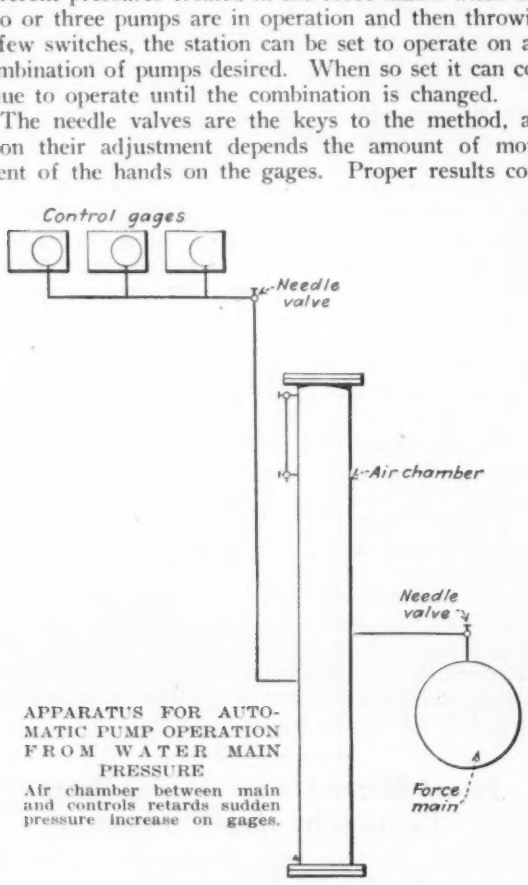
A drop of only 8 ft. was allowed in the standpipe before refilling. This meant that the control contacts had to be set very close together. When a pump first started, heavy pressure was created in the 16-in. force main before the water could get into motion, and the control contacts were much too close together to permit this sudden increase of pressure to pass freely to the gages.

By the use of an air chamber made from two needle valves and a piece of 8-in. pipe 6 ft. long, as shown in the accompanying sketch, it has been possible so to retard the transmission of pressure increase to the gages that the water in the force main gets in motion and the excess pressure drops before the gage pressure increases more than ½ lb.

The station can now be operated with any combina-

tion of the three pumps. By setting the cutoff control on the three gages at different points to allow for the different pressures created in the force mains when one, two or three pumps are in operation and then throwing a few switches, the station can be set to operate on any combination of pumps desired. When so set it can continue to operate until the combination is changed.

The needle valves are the keys to the method, and upon their adjustment depends the amount of movement of the hands on the gages. Proper results could



APPARATUS FOR AUTOMATIC PUMP OPERATION FROM WATER MAIN PRESSURE

Air chamber between main and controls retards sudden pressure increase on gages.

not be obtained with one needle valve; two have been used, one on each side of the air chamber.

One important saving over the old method is the fact that only 15 ft. of electric cable is now required, where before it was necessary to use cable ¼ mile long.

Eliminating Unaccounted-For Flow and Leakage at Akron

By H. Lester Newhall
Chief Engineer, City Water Works, Akron, Ohio

BY MEANS of organized inspection crews covering the city by districts, Akron, Ohio, has appreciably reduced the unaccounted-for flow in its water mains. At the same time many other conditions demanding special and immediate attention have been brought to light.

The system is 100 per cent metered and in addition all water is metered at the pumps. Five years ago the standard test for acceptance was reduced from 200 to 100 gal. per inch-mile per 24 hours. An analysis of test reports covering 1927 construction shows an average for all sizes and pressures from 100 to 250 lb. of less than 30 gal. per inch-mile. Results for the last four months of 1927 show a reduction from 18.2 to 12 per cent of unaccounted-for flow.

Several years ago two inspection crews, each with one experienced man and one laborer and equipped with a Ford car, were organized. These crews were to survey the city by districts. They started on three small high-service areas first and have covered the entire system twice and are now working on the third coverage. These crews worked about 50 per cent of the time, giving the rest of the time to other duties. The work consists of listening with ear phones and steel rods on hydrants, valve stems and house service curb-boxes and reporting to the maintenance division any apparent leakage.

By the repair of several blown joints, pushed off hydrants in swamps, broken mains and services across settled sewer trenches, etc., the actual metered pumpage and percentage of unaccounted-for flow has been reduced as follows:

	M.G.D.	Per Cent Unaccounted For
1921	15.01	27.0
1922	15.57	24.9
1923	16.51	22.5
1924	16.59	23.6
1925	18.45	21.7
1926	18.79	21.9
1927	18.82	21.2

The average unaccounted-for flow has been reduced from 6.19 to 3.93 m.g.d. and the check on valve locations, on the opening of those left closed by mistake, on the repair of hydrants and valves out of order and on other conditions turned in by these crews has been worth much more than the entire cost of their work. We expect this work to lead to still further reductions of waste.

From Job and Office

Hints That Cut Cost and Time

Reconstruction of a Damaged Draw Span

By J. E. Kidd
Louisiana Highway Commission

THE collision of the Steamer "City of Joliet" with the Calcasieu River bridge at Lake Charles, La., on Oct. 25, 1927, necessitated the building of a temporary bridge 800 ft. long with a draw span clearance of 100 ft. This temporary bridge was of the regular trestle type with a 19-ft. clear roadway and three piles to the bent. The superstructure was placed on a 110-ft. steel barge to constitute the draw span. This was opened and closed

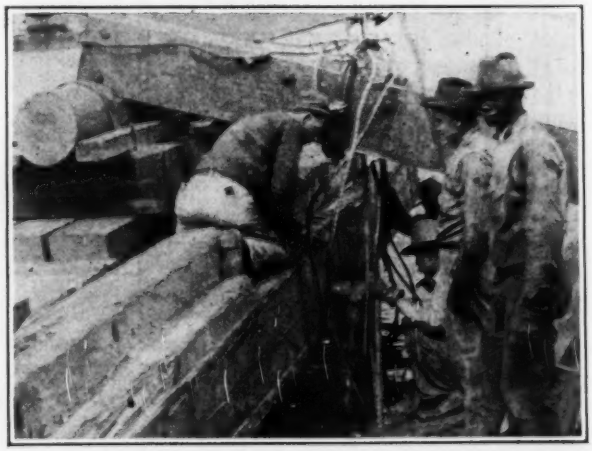


FIG. 1—MAKING THE JACK BEAMS FAST TO A STUBBORN PILE

From Job and Office

For Contractor and Engineer

like a gate by a tugboat attached to the barge by means of rope bridles. Aprons were hinged to the ends of each approach with counterweights and securely fastened to their respective movable barge ends. This arrangement allowed for tide variation. In one instance this variation was as much as 3 ft. overnight. The temporary bridge was completed in fifteen days at a cost of $17,000.

After the repairs to the regular concrete bridge were completed, War Department regulations called for the removal of this temporary bridge. Since further repairs to the concrete bridge were contemplated, which entailed the building of a run-around for the removal of a defective arch, the necessity of saving as many piles as possible was a dominant factor.

FIG. 2—LOAD THROUGH THE JACK BEAMS WAS APPLIED BY TWO DERRICKS AT ONCE

The riverbed borings showed a layer of soft clay mixed with sand, covering a stratum of stiff green clay. All piles in the river channel were driven to practical refusal with lengths varying from 40 to 65 ft., the average penetration being 20 ft. Upon trial it was found that a 30-hp. hoisting engine on a 25x80-ft. barge using the regular load line could not pull the piling. Several piles were pulled by jetting, but this process proved too tedious. Next a 15-hp. hoisting engine on a 20x40-ft. barge was used in connection with the before-mentioned barge, and still the two combined load lines could not pull the piling.

Jack beams were then utilized which consisted of one 12 in. x 12 in. x 14 ft. and one 18 in. x 18 in. x 24 ft. timbers. Both of these were fastened on the larger barge to a 12-ft. cutoff from a pile as a fulcrum. About 4 ft. space was left between the two jack beams. These sizes of material were used as they were available on the job. The pile to be pulled was attached to the two beams by separate cables, so that the loads might be applied independently of one another. This allowed for a rocking motion of each barge. The load lines were then attached to the jack beams and the load was applied.

After the pile had been loosened by this method of jacking with the two barges, the jack cables were removed and the pile was easily pulled by one load line.

The contractor on this job was the Brown Abbott Company of Dallas. The writer was resident engineer.

Pipe Lines Jacked for 200 Ft. Through Railroad Fill

By M. P. Mellon
Ensley, Ala.

JACKING four 6-in. pipe lines for a distance of 200 ft. under a ten-track railroad yard instead of excavating an open cut 19 ft. deep was resorted to in the construction of a 44,000-volt underground transmission line near Birmingham, Ala.

An old hydraulic cylinder with a 6-in. piston and a 5-ft. 3-in. stroke was used in connection with a motor-driven hydraulic jack pump. Gage readings on the pump showed pressures at times reaching 4,500 lb. per sq.in., but the usual pressure required was about 2,000 lb. As shown in the accompanying illustration, built-up channel iron guides started the pipe in the desired direction.

Standard 6-in. wrought-iron pipe was used. The driving point consisted of a forged steel point, 2 ft. long, welded to a length of extra-heavy pipe. This point was recovered and used again for each pipe. Four lines were jacked through in this manner, three for power cables and one for telephone wires. Fifteen hours' time was required to drive each line, effecting a considerable saving in time and cost.

HYDRAULIC JACK DRIVING PIPE LINE THROUGH RAILROAD FILL

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Riveted Brackets

Sir—Along with the very interesting discussion of the tension on rivets and eccentric bending in columns, discussed in recent letters to *Engineering News-Record,* comes the subject of riveted brackets, in which the rivets are in tension and shear. This is usually found under "Stresses in Eccentric Riveted Connections." The location of the point of rotation seems to be a subject for discussion.

In Ketchum's table 118B, the point is in the center of the group. In Hool & Kinne, Structural Connections, p. 339, "the limiting position is the bottom rivet." In Prof. C. R. Young's Structural Problems No. 24 and No. 25, the bracket is figured about the bottom rivet.

These sources are all dependable, but different. I shall appreciate knowing how others handle their brackets.

Painesville, Ohio, May 14, 1928. H. C. BARTLETT.

Stone Fly Larvæ Cause Corrosion of Steel in Running Water

Sir—In the Norwegian periodical *Elektroteknisk Tidskrift* of Feb. 11, 1928, is an article by N. Kolbenstvedt, which the writer finds very interesting. As the matter dealt with seems to be entirely new to Norwegian engineers, the same may be the case with our American colleagues, and for that reason I submit an extract of the article.

Mr. Kolbenstvedt, who was engineer in charge of operation of the Solbergfoss power plant on the River Glommen, found on a visit to a neighboring power plant in 1925 some peculiar formations of rust. The forebay was empty and showed considerable corrosion on all structural parts exposed to water in motion. The formations had the shape and size of half a walnut and seemed to thrive best on the racks of the ice screen, where they were found in such large numbers that they decreased the free area considerably. The master mechanic of the power plant said that the formations were caused by some small "bugs," of which he had collected specimens.

In the autumn of the same year Mr. Kolbenstvedt found great numbers of the same bugs in the turbine spirals at Solbergfoss. He sent some specimens to the zoological museum at Oslo for examination and was informed that they were larvæ of the stone fly.

Formations of rust were not apparent at that time, as the plant had been in operation for not more than a year, but in the autumn of 1927 the plate cones of the turbine spirals were found to be corroded. The protuberances were of the same nature as those found at the other power plant, but were not so large. On the turbines that had been in operation for three years they were about the size of half a hazelnut and on those that had been running for two years they were the size of a pea. The protuberances were quite close together, about three to a square inch, and scratching them off showed that the underlying plate was affected. The racks were not examined, but they are expected to have the same "disease."

Mr. Kolbenstvedt sent samples of the growths to a laboratory at Oslo, where it was found that they chiefly consist of hydrates of iron. When the contents of iron were removed by means of acids, there remained a tangled matter consisting of vegetable residuum, short fibers and sand grains, tied together by many elastic threads. In some cases it was found that the threads were arranged like mesh in a fish net. In two of the growths were found living larvæ of the stone fly, which, when put in a tray of water with some pieces of rust, soon started to tie together the sand grains and fragments of rust by means of the elastic threads which they secrete.

The stone fly is a member of the species of *Trichoptera,* of which there are a great number of sub-species. The larvæ of some of these live in quiet water, whereas others live in swift running streams, as is the case with the specimen here treated of, which is called *Hydropsychidæ.*

The stone fly is a gray, four-winged insect measuring about 1 in. from tip to tip. It occurs in great numbers in power plants and their vicinity. It lays its eggs in water, where the larvæ are developed, and this stage is the most interesting. Like the silkworm, it spins fine threads, which are used for building the nests. These nests have different shapes, according to conditions. The *Hydropsychidæ,* which are about ½ in. long, build a combined nest and catch net in swift currents of water. The nest is a little bag with the opening toward the current and with a small opening at the end. The net is stretched across the large opening facing the current, and in this is caught low animals and vegetable matter that serve as food for the larvæ, which probably do not leave the nest.

It would be interesting to know if any of *Engineering News-Record's* readers have made observations of a similar kind as those here referred to.

Oslo, Norway, May 4, 1928. J. B. NAEUMANN.

Earthquake-Resistant Construction

Sir—The article of H. D. Dewell on "Earthquake-Resistant Construction" in your issues of April 26 and May 3 is an important one. Too few steps have been taken to crystallize engineering opinion and provide some sort of definite design guidance for practicing engineers, particularly as to the design of buildings more than eight or ten stories in height.

While there is apparent concurrence of opinion as regards the design for buildings up to about ten stories, for higher buildings there have arisen two separate and rather widely divergent schools of design. This is unfortunate, as the more difficult problem, and at the same time the one on which our actual experience is the most meager, has to do with high buildings. One school, of which Mr. Dewell is a proponent, recommends the utmost possible in rigidity of construction, while the other advocates a flexible construction.

It would appear to the writer that Mr. Dewell has perhaps based his recommendations too much upon the work of Japanese investigators; extrapolating their results to embrace high buildings, with which they have had little or no experience. Mr. Dewell criticises the flexible-column method of design on the ground that resonance might occur with the period of the earth vibration. In order to damp the vibration of the building and destroy any well-defined period, the lengths of the first-story columns could be varied. Probably the most practical way of accomplishing this would be to make a portion of the second-story or mezzanine-beam connections stiff and a portion flexible. Columns turned part with their flanges in one direction and others with their flanges at right angles thereto would also have the same effect. In any case the chance of resonance except for one or two vibrations is small, since the period of the earth vibration is continually varying.

It seems that one rather serious objection to designing a building as a rigid structure to follow the earth vibration is that the stresses produced in the structure in that case vary directly as the acceleration of the earthquake. As Mr. Dewell points out, our information regarding the accelerations to expect at a given locality and on a given building site is far from complete. It is somewhat analogous to determining the maximum flood discharge and freeboard to provide for in an earth dam; if our estimate is too low, the dam is endangered; if too high, it is not economical.

The writer believes that the question of weight in its effect on earthquake stresses is worthy of mention. Reducing dead weight is perhaps the most obvious method of reducing earthquake stresses. Heavy masonry walls designed to take earthquake stress are from that point of view undesirable, since a steel frame of equal rigidity and strength will be much lighter. Some of the newer types of light-weight floor and wall construction are particularly advantageous in earthquake regions.

NORMAN B. GREEN,
Structural Engineer.

San Francisco, Calif.,
May 8, 1928.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Potter Superseded as Head of Mississippi River Commission

President Makes Recess Appointment of Col. Thomas H. Jackson of the Engineer Corps

A RECESS appointment of Colonel Thomas H. Jackson, Corps of Engineers, U. S. Army, to succeed Col. Charles L. Potter was made by President Coolidge on June 11. Colonel Potter has been serving as president of the commission under a temporary appointment, having passed the retirement age, and it was generally assumed that he would be continued in that position at least until the special flood-control board of which he would automatically have been a member had completed its studies and made its report to Congress.

Colonel Jackson has been serving as engineer of the Gulf Division at New Orleans. Before the war he served on the California Débris Commission and in that work gained considerable experience in flood-control work. By virtue of his appointment as president of the Mississippi River Commission Colonel Jackson becomes a member of the special flood-control board, of which Major Gen. Edgar Jadwin and Carlton W. Sturtevant are the other members. Under the flood-control act his rank is that of a brigadier general.

Edgewood Cutoff Completed

The new 169-mile Edgewood cutoff of the Illinois Central, from Edgewood, Ill., to Fulton, Ky., has been finished at a cost of more than $15,000,000. The new route saves 22 miles for southbound traffic from Chicago, besides reducing grades and curves. There are three tunnels, the longest 6,985 ft.

Town Meeting Unanimous Against Building Sewage-Works

At a recent town meeting the taxpayers of East Greenwich, R. I., voted unanimously against a bond issue of $92,000 for the building of sewage-works ordered by the State Board of Purification of Waters. In the course of a lengthy debate before the vote it was strenuously urged that the order was "unfair" and that a part of the cost of preventing the pollution of Greenwich Bay should by right be borne by the state. It was also alleged that the State Board of Purification of Waters had been "derelict" through having permitted the city of Pawtucket and other towns to continue pollution of state waters.

Mid-Hudson Bridge Caisson Being Righted

Operations to right the listed east main pier caisson of the Mid-Hudson bridge, under construction at Poughkeepsie, N. Y., have been in progress with some success for the past two months, since the resumption of work after the winter shutdown. The caisson suddenly listed on July 27, 1927, while in the early stages of sinking, and tipped to an angle of 43½ deg. from the vertical. No progress was made in righting it during the 1927 season. Operations this spring included dredging under the high side of the caisson and pulling westward on the upper edge by heavy tackle. On May 11 the first movement, of 2 or 3 in. was noticed, and by June 11 the movement was about 3 ft., the list then being 41½ deg.

The caisson is a reinforced-concrete open-dredging pier 60x136 ft., and is to go more than 100 ft. below water. Its present height is 84 ft. It was built on land, launched and brought to the site, and sunk by loading and opening some of the bottom bulkheads of the wells. There are 25 dredging wells in the rectangular main part and the semi-circular end sections, and the walls are in general about 3 ft. thick. The structure has a total present weight of about 19,000 tons and a submerged weight of 12,000 tons.

The Blakeslee-Rollins Corporation is contractor for the work and has successfully sunk the west pier. The bridge is being built for the state of New York, Frederick S. Greene, Superintendent of Public Works. Modjeski & Moran are consulting engineers to the department.

Los Angeles Approves Breakwater and Port Extensions

Extension of the harbor breakwater and the port facilities of Los Angeles has been approved by the city council. The cost of the improvement is estimated at $18,000,000, part of which will be paid by the federal government. The plan calls for consolidating railroad facilities and unification with Long Beach harbor for operating purposes.

Boston & Maine Opens New Yard

A new classification yard to serve Boston, constructed at a cost of $4,000,000, has been placed in service by the Boston & Maine Railroad. The yard is located in Cambridge and Somerville, Mass. It is laid out with two humps, one for incoming and one for outgoing freight, and has automatic car retarders More than 2,000 people were present at the dedication ceremonies.

Many Subjects Treated By Prominent Speakers At N.E.L.A. Meeting

Right to Spread Information to the Public Is Upheld—Work of the Year Reviewed

THE 51st annual convention of the National Electric Light Association, held in Atlantic City, N. J., June 4 to 8, was attended by more than 8,000 persons. Besides the usual convention reports and papers concerned with the many phases of the electrical industry, such as regulations, finance, commercial problems, accounting, public policy, insurance and employee relations, there were a number of notable addresses by leaders of industrial thought. Exhibits of material and equipment were held by 209 manufacturing companies. Announcement was made that a sum of $300,000 per year for the next ten years has been made available for research under National Electric Light Association direction.

The Federal Trade Commission investigation of the activities of various state committees on public utility information received much attention. A statement that the industry accepts full responsibility for its actions and that it fully maintains its right to use every legitimate means for presenting to the public the story of its accomplishments and problems was issued by the convention.

The Coffin award went to the Puget Sound Power & Light Company for outstanding accomplishments in rural development, domestic load building and railroad electrification.

Among the committee reports those of the water-power development committee, Paul A. Schoellkopf, chairman, and the committee on electrification of steam railroads, Britton I. Budd, chairman, are of especial interest to civil engineers. Abstracts of these reports will appear in *Engineering News-Record* in the near future.

Many outstanding names appeared on the list of speakers. A. W. Thompson, president of the United Gas Improvement Company, brought out the fact that the function of the investment and holding company is to maintain a staff of skilled experts always available to its operating companies and to provide funds for necessary improvements. H. P. Davis, chairman of the board, National Broadcasting Company, outlined the growth of radio and its effect upon the central-station load. John E. Edgerton, president of the National Association of Manufacturers, spoke on the relation of government and business, laying the onus of political mistakes to

public indifference. Merle Thorpe, editor of *Nation's Business*, treated the same subject from the angle of paternalism, the American brand of socialism. James H. McGraw, president of the McGraw-Hill Publishing Company, Inc., discussed the major principles of industrial selling. Samuel M. Vauclain, president of the Baldwin Locomotive Works, made the prophecy that all trunk-line railroads and 50-mile laterals along the Atlantic coast from Boston to Washington will be electrified within the next ten years. Lawrence A. Downs, president of the Illinois Central Railroad, described the recent electrification of his road in the vicinity of Chicago. Clifford V. Gregory, of the *Prairie Farmer*, told of the progress of rural electrification, and William P. McCracken, Assistant Secretary of Commerce in charge of aviation, spoke on commercial aeronautics.

Institute of Steel Construction Organizes Field Force

In an effort to promote sound engineering practice and the welfare of the structural steel industry, the American Institute of Steel Construction has recently organized and will shortly place in active service a staff of ten district field engineers.

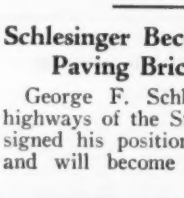
A training school for the district engineers was opened in Cleveland on May 15, under the direction of Lee H. Miller, the Institute's chief engineer. The district engineers are as follows: E. N. Adams, J. N. Keenan, B. J. Hastings, Alexander Miller, J. G. Allen, Henry Penn, C. C. Tracy, G. E. Doyen, Jack Singleton and W. E. Emmett.

St. Louis Engineers Club Burns Mortgage

With final payments made on its new building at 4359 Lindell Ave., the Engineers' Club of St. Louis celebrated its sixtieth annual dinner, on June 6, by burning the mortgage to the building, which was purchased four years ago. An active campaign during that period has increased the membership from about 500 in 1924 to nearly 800 in 1928, while its assets have increased in the same period from $1,500 to $65,000, as stated in the address of W. W. Horner, retiring president. Besides an address by Arthur S. Hawks, president for 1928-29, there were talks by six past-presidents: Philip N. Moore, 1873; Herbert A. Wheeler, 1884; F. E. Bausch, 1895; William E. Rolfe, 1909; J. E. Vollmar, 1913, and W. L. Upson, 1921. The special address of the evening was by Arthur W. Berresford, president of the American Engineering Council, on "The Engineer and the Nation's Business." The club has also inaugurated a new idea in publishing its 1928 membership list with a portrait of each member opposite his name. It contains a history of the club by Edward E. Wall. Of 30 present members who were on the roll during the first half of the club's existence, fifteen met at the dinner, and letters and telegrams were received from nearly all the others. The Engineers' Club of St. Louis is said to be the third oldest engineering organization in the United States.

Schlesinger Becomes Manager of Paving Brick Association

George F. Schlesinger, director of highways of the State of Ohio, has resigned his position, effective June 15, and will become chief engineer and managing director of the National Paving Brick Manufacturers Association. The headquarters of the latter association, which are now in Chicago, will be moved to Washington, D. C.



After his graduation from Ohio State University in 1907, Mr. Schlesinger was engaged principally in railroad engineering, being division engineer with the Rock Island Lines in Kansas and Missouri for about five years. In the fall of 1913 he became a member of the faculty of Ohio State University in the department of civil engineering, and left there during the war for government employment as an engineer on the construction of the Columbus reserve depot. He entered the highway department as division engineer in the Cincinnati district and was later promoted to chief engineer of construction. In July, 1923, Mr. Schlesinger was made state highway engineer, and on Aug. 11, 1925, was appointed to succeed L. A. Boulay as director of highways and public works. Mr. Schlesinger is a member of the American Society of Civil Engineers and past-president of the Central Ohio section of that society. He is also a past-president of the Ohio Engineering Society, the Columbus Engineers Club and the Mississippi Valley Association of State Highway Departments. In addition, he is serving as a member of the executive committee of the American Association of State Highway Officials.

Railroad Improvements Planned for Baltimore

The Pennsylvania Railroad is planning extensive improvements to its lines in Baltimore which will include additional tunnels, electrification, a new Calvert station and other features, at a total cost of about $22,000,000. Three ordinances providing for the improvements are before the Baltimore city council, and public hearings are being held by the committee on railways and franchises and the Board of Estimate. Herman F. Lucke, Jr., consulting engineer, has been named as the representative of the city in connection with the improvements, at a salary of $5,000. He will work under the general supervision of Charles F. Goob, chief engineer and head of the department of public works.

An advisory commission to act in a consulting and supervisory capacity over the other municipal agencies engaged in the enterprise is under formation. Among those who have been asked to serve are Dr. John B. Whitehead, dean of the school of engineering, Johns Hopkins University, and John E. Greiner, consulting engineer. Each of the city newspapers has been asked to name a representative for the commission.

Memorial to Merritt H. Smith

As a memorial to Merritt H. Smith, for 40 years an engineer connected with the water supply of New York City, a committee of engineers is making plans to place a bronze portrait medallion upon one of the stone pavilions at the base of Kensico dam of the New York water-supply system, the most monumental of all the dams which were built under his direction. The medallion will be approximately life size. It will be set on a simple granite panel bearing the following inscription:

MERRITT HAVILAND SMITH
Engineer, for Forty Years, of the Water Supply of the City of New York
Colonel of Artillery in the Great War
1862-1926

J. Waldo Smith, consulting engineer of the Board of Water Supply, New York City, is chairman of the committee raising funds for the work.

Illinois Sanitary Association Dedicates Sewage-Works

A special function at the annual meeting of the Illinois Association of Sanitary Districts, held at Bloomington, Ill., on June 6 and 7, was the dedication of the new sewage-works of the Bloomington and Normal Sanitary District. This was the association's second function of the kind, the Elgin works having been dedicated at the 1927 meeting. Another interesting feature was the presentation of brief reports by representatives of nearly all the twenty sanitary districts in the state, showing the status of their projects or construction or outlining difficulties and experiences in operation.

A review of legislation relative to sanitary districts, as indorsed by the association and passed by the Illinois Legislature, was discussed at some length and, after some objection a method of keeping track of legislation affecting the interests of drainage districts, was approved. The desirability of a standard cost record system, to permit definite comparisons among different districts, was outlined by H. F. Ferguson, chief state sanitary engineer. Dr. A. M. Buswell, director of the State Water Survey, reviewed the experimental work under his direction. A paper on "Pathogenic Bacteriology of Sewage" was read by Miss Dorothy Day, Urbana, and experiments in the use of chlorine treatment of sewage

were explained by L. H. Enslow. Recent developments in sludge digestion were reviewed by Dr. F. W. Mohlman, Chicago Sanitary District. In discussion of a paper on "Yearly Short Courses for Sewage-Plant Operators" it was suggested that a meeting for operators be arranged in connection with the next annual meeting of the association; also that officials of districts in Illinois should urge their operators to join the Central States Association of Sewage-Works Operators.

There was a registered attendance of about 75 members and visitors. Officers of the association elected for 1928-29 include: President, Harry F. Ferguson, chief state sanitary engineer, Springfield, Ill.; vice-president, John Oliver, Highland Park, Ill.; secretary and treasurer, Gus H. Radebaugh, Urbana, Ill. The next annual meeting will be held at Springfield, Ill.

Canadian Paper Mill Projects Total Millions

Plans for expansion in the paper industry in eastern Canada call for the construction of many new paper mills and power plants. In Nova Scotia preliminary surveys are now being made for a $10,000,000 newsprint and hydro-electric development to be undertaken by the Royal Securities Corporation. The company is planning to construct and operate for a 30-year period a paper mill on the waterfront near Liverpool, N. S., with a capacity of 250 tons of newsprint per day. It is planned to have the mill in operation by January, 1930. The Nova Scotia Power Commission will undertake three separate power developments on the Mersey River at Lake Falls, Big Falls and Lower Great Brook Falls. These will have a total capacity of 20,000 hp., supplying a maximum of 105,000,000 kw.-hr. per year to the paper mill. The power will be supplied to the company at cost for 40 years. The work of developing hydro-electric power will begin this summer.

In the Province of New Brunswick the Canadian International Paper Company is planning the erection of two new mills at Dalhousie, on the Restigouche River, and also a 100-ton sulphite pulp plant on the Miramichi River. The estimated cost of these plants is $20,000,000. The Fraser Companies, Ltd., will erect a new sulphite pulp mill costing in the neighborhood of $4,500,000 at Athol, on the Restigouche River. The same company proposes either to erect a new 100-ton pulp mill or to extend its present plant to a capacity of 100 tons per day at Millbank, on the Miramichi River. These projects, together with the expenditure on development of Grand Falls for hydro power purposes, will bring the immediate capital expenditure very close to $40,000,000.

The International Paper Company has acquired by purchase and by registration of options an area of 100 acres near St. Leonard, N. B., probably for the erection of a new pulp mill.

Asphalt Paving Conference to Be Held in New Orleans

New Orleans was chosen as the scene of the seventh annual Asphalt Paving Conference at a recent meeting of the board of directors held in Chicago. It is estimated that from 1,000 to 1,500 interested persons will be present at the conference, which will take place the week of Dec. 10. The American Association of Asphalt Paving Technologists and the Asphalt Association, as well as other organizations, will hold their annual meetings in connection with the conference.

Progress at Pardee Dam on the Mokelumne Project

On June 1, 61,200 cu.yd. of concrete had been poured in the Pardee dam, which is being built on the Mokelumne River, California, for the East Bay Municipal Utility District. Despite delays due to high water when excavation in the streambed was being made, the elapsed time now checks with the corresponding percentage of completion, and it is expected that the contract will be finished ahead of schedule. The dam is now above the point where there is danger of flood interference.

Syracuse to Spend $35,000,000 in Ten Years

The city of Syracuse, N. Y., will spend approximately $35,000,000 for pavement, sewers and water-line extensions in the next ten years, according to estimates submitted to the Municipal Research Committee by City Engineer N. F. Pitts, Jr. The estimate provides for the paving of 300 miles of streets at a cost of about $22,000,000, sewers to cost about $5,000,000 and additions to the water-distribution system in the new annexations to the city at a cost of about $8,000,000.

Ypsilanti Sticks to Ownership of Its Gas Works

A proposal to sell the municipally owned gas works of Ypsilanti, Mich., for private operation was recently defeated by the voters, 2,050 to 620. The city bought the plant thirteen years ago for $130,000, is carrying it at a book value of $305,000 and rejected the offer to sell it for $752,000.

Great Falls Development Banned

The bill restraining the Federal Power Commission from granting any permit for development of the Potomac River near Washington was passed by Congress during the closing hours of the session and has been approved by President Coolidge. That part of the river affected lies between the mouth of Rock Creek and a point 4 miles above the present water-supply intake, and includes the famous Great Falls of the Potomac. The purpose of the bill is to preserve the scenic beauty of the river for future park purposes. The bill was supported by the National Capital Park and Planning Commission.

NIGHT WORK SPEEDS COOLIDGE DAM CONSTRUCTION

Coolidge dam, on the Gila River in Arizona, is now in its final construction stage. This picture, taken early in May, shows the concrete well up toward the upper part of the three great domes that form the major part of the dam. The total height will be 250 ft. Excavation for one of the spillways is shown at the left. Major C. R. Alberg is the engineer. The contractor is the Atkinson, Kier Bros., Spicer Company.

Washington Notes

Jackson to Succeed Potter on Mississippi Commission—City Officials Added to Road Builders

By Paul Wooton
Washington Correspondent

SUBSTITUTION of Col. Thomas H. Jackson for Col. Charles L. Potter as president of the Mississippi River Commission through a recess appointment made on Monday came as a great surprise. The President's action was in disregard of the formally expressed desire of all members of the commerce committee of the Senate and all but one member of the flood-control committee of the House. In not continuing Colonel Potter as head of the commission it is believed that the President was influenced by the fact that Colonel Potter held to certain views not shared by the majority of the commission. Also, it is believed that the administration officials considered Colonel Potter's tenacious clinging to his views to have antagonized many people in the Valley. Consideration of these factors is thought to have influenced the President to select another man of outstanding ability and experience in flood-control work to head the commission despite the provision written into the flood-control bill which authorized the recall of Colonel Potter from the retired list for that purpose.

Boulder Dam Survey

The President is being urged to obtain recommendations from American Engineering Council in connection with the board of engineers that under the Pittman resolution is empowered to make a thorough study of the Boulder dam project. It is known that American Engineering Council has given consideration to this matter. Since the Secretary of the Interior is out of town, however, and will not be back until July, no steps can be taken at present, inasmuch as he is directly charged with selecting this board of engineers.

New Division of Road Builders

City highway officials representing 24 states met in Washington on June 8, with leaders of the American Road Builders' Association and voted unanimously to be incorporated as a part of that association, under the title of the City Officials Division. Capt. H. C. Whitehurst, assistant to the engineer commissioner of the District of Columbia, was elected president of the new division. Vice-presidents were elected as follows: C. E. Myers, director of transit, Philadelphia, Pa., for the Northeastern district; Ben S. Davidson, commissioner of streets and bridges, Houston, Tex., for the Southern district; W. R. Hopkins, city manager, Cleveland, Ohio, for the Central district and John Claude Shaw, city engineer, Los Angeles, Calif., for the Western district.

Under tentative plans the work will be divided among four major committees. These are committees on: Plans, Designs and Specifications; Construction; Maintenance; and Traffic. In connection with traffic studies it was announced that particular attention will be given to the Hoover code.

In general, officers of the association stated, this new division will pursue a policy of close co-operation with other associations and industries interested in the work. The committee on maintenance, in making a study of paving materials used between street-car rails, will keep in close touch with the American Railway Association. Although the findings of this new division will be in the nature of recommendations, it is expected that they will be readily approved, not only to accomplish standardization in city traffic methods but also to obviate the necessity of the federal government assuming control of highway and traffic practice.

Brief News

The Moffat Tunnel Commission has received from the Denver & Salt Lake Railroad Company a payment of $131,000 covering rental of the tunnel for a period 4½ months up to July 1. A statement of the railroad indicates that the tunnel rental at the present time is more than the saving in hauling costs and that unless more freight traffic is obtained the tunnel will be a liability and not an asset.

A Memorial Bridge connecting the two Washington Crossing memorial parks, one in New Jersey and the other in Pennsylvania, was the subject of a conference of representatives of the two states on June 5 at Washington Crossing, N. J. It is the plan to build the bridge under federal auspices.

A Cold-Storage Plant at Halifax, N. S., to cost approximately $2,500,000, will be erected by the Foundation Company, Ltd., of Canada on property close to the ocean terminals in the south end of the city. There will be four reinforced-concrete buildings of six stories.

Construction Work on the highway bridge over the Cooper River at Charleston was started during the latter part of May. The four chief contracts for construction work have been awarded to the following: The Foundation Company, substructure for the heavy spans; Charles E. Hillyer, Jacksonville, Fla., substructure for the approaches; McClintic-Marshall Company, Pittsburgh, for the main superstructure, and Virginia Bridge & Iron Company, Roanoke, Va., for the approach superstructure. The final cost of the bridge is placed at $5,750,000, while the four contracts so far let total $3,701,000, according to H. M. Byllesby & Company, financiers of the project. It is expected that the 2¾-mile structure will be completed in seventeen months. Waddell & Hardesty, New York, are the engineers.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Meeting, University of North Carolina, June 25.

AMERICAN INSTITUTE OF QUANTITY SURVEYORS, Chicago; Annual Convention, New York, June 25-27.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, June 25-29.

AMERICAN SOCIETY OF CIVIL ENGINEERS; Annual Convention, Buffalo, N. Y., July 18-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Convention, Detroit, Mich., Oct. 22-28.

The Engineering Institute of Canada held its Western general professional meeting at Vancouver, B. C., June 7 to 9. Among the papers presented of interest to civil engineers were "Some Engineering Aspects of the Bridge River Projects," by E. E. Carpenter, of the British Columbia Electric Railway Company, Vancouver; and "Irrigation in Mountainous Country," by F. W. Groves, consulting engineer, Kelowna, B. C.

The Central States Sewage Works Association, organized in 1927, held its first annual meeting at Milwaukee, Wis., on May 25 and 26. Among the papers presented were: "Chicago's Sewage-Treatment Program," Langdon Pearse (represented by S. L. Tolman); "Sewage-Treatment Accomplishments at Milwaukee," Robert Cramer; "Separate Sludge Digestion at Antigo, Wis.," Jerry Donahue; "Sewage-Treatment Plant for Small Municipalities," Walter A. Pierce; "Aims of the Association," Adolph Kanneberg. Officers elected for 1928-29 are as follows: President, Robert Cramer, chief engineer, Milwaukee Sewage Commission; vice-presidents, Lewis S. Finch, Indiana State Board of Health, and F. W. Mohlman, chemist for the Sanitary District of Chicago; secretary, G. H. Radebaugh, manager, Urbana-Champaign Sanitary District, Urbana, Ill., treasurer, L. F. Warrick, state sanitary engineer, Madison, Wis.

The Engineers Club of St. Louis has elected officers as follows for 1928-29: President, A. S. Hawks, chief engineer of the Busch-Sulzer Brothers Diesel Engine Company; vice-presidents, F. C. Woermann, W. E. McCourt and W. O. Pennell.

The Rhode Island Chapter, American Society for Steel Treating, at its annual meeting on May 16, elected officers as follows: Chairman, Eugene J. Sullivan; vice-chairman, James E. Hines; secretary-treasurer, Carl G. Peterson.

Personal Notes

Col. HARLEY B. FERGUSON, Corps of Engineers, U. S. Army, division engineer stationed at New Orleans, La., has been transferred to Cincinnati, Ohio, to succeed Colonel Kutz, ordered to Honolulu.

Col. THOMAS H. JACKSON, district engineer for the U. S. Army at San Francisco, has been ordered to report for duty at New Orleans.

O. J. MILLER, for the past five years superintendent of production for the Tennessee Electric Power Company, has been appointed manager of the production and transmission departments of the company, in which capacity he will be responsible for the operation of all of the company's power stations and the construction and operation of the transmission lines throughout the territory served by the company in middle and east Tennessee. Mr. Miller was graduated in civil engineering from Ohio State University in 1916. He has been with the Tennessee Power Company since 1920.

MYRON D. DOWNS, who is now making a city plan for New Orleans, has been engaged as secretary-treasurer of the City Planning Commission of Cincinnati and is expected to begin his work in that city on July 1. Mr. Downs is a graduate of the University of Illinois and has been engaged in city planning work since 1921.

FRANCIS BATES, of Los Angeles, Calif., announces association with his brother, Bennett R. Bates, in the formation of Bates Company, engineers, to carry on the practice of consulting and general engineering, with offices in Los Angeles. The company will specialize, among other things, in city planning and traffic studies, storm drains, subdivision development, grade separations, sanitation and water treatment.

ELMER L. FERGUSON, for the past four years resident engineer for the Burns & McDonnell Engineering Company, of Kansas City, Mo., has purchased the engineering business of W. H. Luse, at Sioux City, Iowa. Mr. Ferguson was employed in Sioux City for eleven years before leaving for Kansas City. His work in recent years has been on waterworks, sewers and power plants, and he will add these lines to the drainage and other engineering work formerly handled by the office which he is taking over.

W. H. LUSE, who has been conducting an engineering practice at Sioux City, Iowa, was elected commissioner of streets and public improvements for that city in the recent spring election. Mr. Luse has been a resident of Sioux City for about fourteen years, having worked for the county highway department and for the engineering firm of Taylor & Moriarty before going into business for himself. In order that he might devote his entire time to the city's interests, he has disposed of his private practice and given up his drainage engineering work.

WILLIAM W. SMALL has been appointed city engineer of Oklahoma City, Okla., succeeding B. M. Hart, who has been made city engineer of Tulsa.

N. M. ISABELLA, division engineer of the Wisconsin State Highway Department, has resigned to become engineer for the Morris Martin Construction Company, Berlin, Wis.

JOHN SNYDER has been appointed city engineer of Oswego, N. Y., succeeding the late James Burden. Mr. Snyder held this same position several years ago, but has lately been with the Solvay Process Works of Syracuse.

J. F. SELLER, bridge engineer of the Wyoming State Highway Department, has resigned and left for Evansville Ind., June 3. His future plans are not known.

N. ALTIERY, formerly municipal engineer for the city of Fort Myers, Fla., and for the past three years with the engineering and construction division on the Broad St. subway, Philadelphia, is now managing engineer with the U. S. Engineering Company, Philadelphia.

BURNSIDE R. VALUE, recently with the Morton C. Tuttle Company, Boston, has gone to Detroit to be supervising engineer for the firm of Parsons, Klapp, Brinckerhoff & Douglas, on the construction of the vehicular tunnel between Detroit and Windsor.

C. L. MCKESSON, chief material and research engineer for the California State Division of Highways, has resigned to accept a position with a San Francisco paving company.

C. HAROLD BERRY, for the last three years associate editor of *Power*, has been appointed professor of mechanical engineering in the engineering school of Harvard University, to succeed Dr. Harvey N. Davis, recently elected to the presidency of Stevens Institute. Mr. Berry will assume his new duties on Sept. 1.

A. R. KETTERSON has been appointed assistant engineer of bridges, Canadian Pacific Railway, with headquarters at Montreal. Mr. Ketterson entered the service of the Canadian Pacific as bridge inspector in the chief engineer's office in 1907. In 1919 he was appointed to the chief engineer's department.

R. F. GRAY, superintendent of Lake Cheesman, Denver, water system, has resigned and has been succeeded by Frank B. Young, who has been with the water company for about 34 years.

JAMES S. BOWMAN, who has been hydraulic engineer with the Fargo Engineering Company, of Jackson, Mich., for the past eight years, has severed his connection with that organization and is now with L. F. Harza, consulting engineer, of Chicago, in a similar capacity. Prior to going with the Fargo Engineering Company, Mr. Bowman was in irrigation work near Sheridan, Wyo., and spent four years with the Miami Conservancy District, Dayton, Ohio, on designs and construction.

H. S. EVANS, dean of the college of engineering, University of Colorado, Boulder, was honored with the degree of Doctor of Science by his alma mater, the University of Nebraska, on June 2.

W. W. GRIFFIN was recently transferred from the engineering staff on the Bellows Falls hydro development of the New England Power Construction Company to the engineering staff of the transmission department as assistant engineer. Mr. Griffin is a graduate of Syracuse University and previous to the Bellows Falls development was employed by the Wayagamack Pulp & Paper Company, Ltd., of Three Rivers, Que., as resident engineer on the Flam-and Vermillion development.

Obituary

JAMES MADISON PORTER, consulting engineer and for many years head of the civil engineering department at Lafayette College, died on June 3 at Easton, Pa. He was 64 years old. Excepting four years spent in the design and erection of water-works, standpipes, bridges and turntables and a year in Europe investigating bridges, waterworks and sewerage, Professor Porter spent his life in building up the civil engineering department at Lafayette.

RICHARD SCHERMERHORN, SR., died on May 20 at Brooklyn, N. Y., at the age of 79. One of the oldest members of the Am.Soc.C.E., Mr. Schermerhorn was widely known for his work in the construction of the old Prospect Park & Coney Island Railroad. He also acted as this road's first superintendent and manager.

FRANK TURNER, assistant chief engineer of the Texas & Pacific Railroad, with headquarters in Dallas, died on May 21 as the result of injuries received when he was struck by a breaking derrick boom while he was inspecting a bridge which the railroad company is constructing over the Atchafalaya River.

S. J. HAYDE, a retired building contractor, of Kansas City, Mo., died suddenly while riding on a train on May 16. Mr. Hayde was the inventor and patentee of "Haydite," a light-weight aggregate for making concrete. He gave up his contracting business to devote his time to the development of his invention. Mr. Hayde was 64 years old.

CHARLES STONE, for 32 years superintendent of the Anaheim (Calif.) Union Water Company, retiring three years ago, died in Richfield, Calif., May 20. He was 73 years old.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Railway Tie Producers Meet

At the recent annual meeting of the National Association of Railway Tie Producers the usual program of papers and reports was enlivened by a contest for hewing ties. Three men selected by preliminary contests entered the lists and each produced a tie from a round log. Papers included "The Future Demand for Cross-Ties," by Earl Stimson, chief engineer of maintenance, Baltimore & Ohio Railroad; "Failures of Substitute Ties," by Prof. Nelson C. Brown, New York State College of Forestry; and "Forests and Floods," by W. W. Ashe, National Forest Reservation Commission. Proposed specifications for ties for industrial tracks were referred to the board of directors. Reports indicated a falling off in production and demand but ample stocks in hand. Officers for 1928-29 are as follows: President, Robert E. Lee, Hobart-Lee Tie Company, Springfield, Mo.; vice-presidents, J. J. Schafly, Potosi Tie & Lumber Company, St. Louis, Mo., and F. Fonville, G. W. Signor Tie Company, Shreveport, La.; secretary (re-elected), Roy M. Edmonds, St. Louis, Mo.

Test Codes for Steam Turbines Discussed by Eight Nations

The meeting of the steam turbine advisory committee of the International Electrotechnical Commission held at The Hague, Holland, during the week of May 20 is reported to have been most successful. Eight nations were represented by 23 delegates, who are attempting to reconcile the various test codes for steam turbines now used throughout the world and to develop a standard code for international adoption. The United States was represented at the meeting by I. E. Moultrop, chief engineer and assistant superintendent, construction bureau, Edison Electric Illuminating Company of Boston; and Francis Hodgkinson, consulting mechanical engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. C. B. LePage, assistant secretary, A.S.M.E., also attended the meeting as assistant director of the secretariat to the advisory committee.

American Road Builders to Take Part in Mexican Road Congress

The American Road Builders' Association has accepted an invitation of the Mexican federal highway commission and government to participate in the second national highway congress and exposition to be held in Mexico City, Oct. 3-6. Invitations have also been sent to South and Central American countries.

Mexico has completed its third year of federal road construction and has as one of its present objectives the completion of the highway from the United States border to Mexico City, a distance of about 800 miles.

The A.R.B.A. will exhibit the latest methods of highway engineering, showing plans, maps, details and specifications used in the United States. In addition, the most recently developed construction methods will be shown by movies and photographs. Road-building equipment and materials will be exhibited and arrangements have been made for demonstrations of road-building machinery.

Acceptance of the invitation was made through the A.R.B.A.'s Pan-American division, which was recently organized. Special freight rates have been obtained for shipping road-building machinery to Mexico, and reduced passenger fares will be in force.

Business Notes

MIDWEST LOCOMOTIVE WORKS, Cincinnati, Ohio, has been taken over by the owners of the Columbia Machine Tool Co. and the Ceramic Machinery Co. of Hamilton, Ohio, to which city the locomotive works have been moved. Locomotives from 3- to 15-ton capacity will be manufactured from the designs heretofore used in Cincinnati, and larger sizes will be added to the line at an early date, according to an announcement. Repairs for the Burton friction drive locomotives formerly built by the Burton Co., the predecessor of the old Midwest Locomotive Works, will be furnished as heretofore. Several officers of the old company are going with the new organization, including J. C. Meyers, purchasing agent and office manager; Ray Doll, shop superintendent; and George Marsh, foreman.

NORDBERG MANUFACTURING COMPANY, Milwaukee, Wis., has for some time past manufactured a machine for shifting railway track. The original machine was adaptable only to standard-gage tracks. The company has now developed a machine suitable for track of gages as narrow as 36 in., and this machine is now available.

EQUIPMENT CORPORATION OF AMERICA, Chicago, has recently purchased from the Allis-Chalmers Manufacturing Co. an industrial property 200x600 ft. in Chicago. The present buildings on the site will be remodeled and re-equipped for the rebuilding of contractors' equipment. The present year marks the company's 25th anniversary. In addition to this new plant the company has branches in Pittsburgh, Philadelphia and Chicago Heights, the latter devoted entirely to the manufacture of new equipment.

FREDERICK IRON & STEEL COMPANY, Frederick, Md., announces that it is now manufacturing both hand- and power-operated diaphragm pumps.

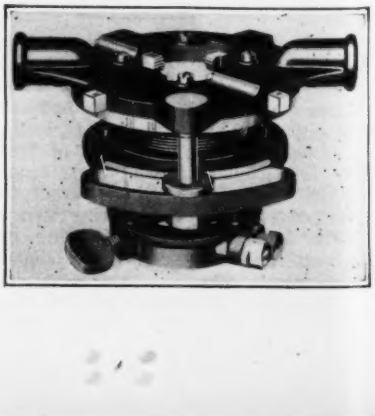
New Developments

A New Crawler Tractor

A new crawler tractor, which is a combination of the McCormick-Deering 10-20 tractor and the Trackson crawler unit, has been announced by the Trackson Company, Milwaukee, Wis. The new unit is a 3½-ton machine which will benefit by the distribution and service facilities of both the International Harvester Company and the Trackson Company. The crawler unit is so designed as to leave the frame of the tractor unobstructed. In addition special details have been incorporated in the design which make easy the attachment to the tractor of such units as hoists, loaders, diggers, backfillers, etc. The weight of the tractor complete is 7,200 lb., while the weight of the crawler unit is approximately 4,250 lb. The crawlers exert a ground pressure of 4½ lb. per sq.in. They are heat treated electric alloy steel castings 12 in. wide, self-aligning on the sprockets and of non-clogging design. Brakes are controlled through a regular steering hand wheel, and heavy duty copper-inserted asbestos brake linings are used on a 16-in. brake drum. Grouters can be supplied for the track shoes when necessary.

New Pipe-Threading Machines Use Integral Adjustable Dies

Two new designs of the Beaver die stocks brought out by the Borden Company, Warren, Ohio, include improvements which give greater simplicity and easier working, with reduced weight and price. In these new tools one set of dies is quickly set to thread 1, 1¼, 1½ or 2 in. without changing dies. The dies cannot become lost or mislaid, because they are always in the tool, and



they are quickly adjusted to thread under or over standard without affecting the length of the thread. No special dies are needed for brass pipe. The dies are of high-grade alloy steel, hardened and tempered, and thus give long life. The die head and threaded barrel are two separate parts, so that for repairs only one part need be bought. In the new work holder or pipe gripping device, which centers the pipe more accurately, two knurled screws hold the pipe, leaving only the thumbscrew to be tightened after the die stock is placed on the pipe. Loose bushings are eliminated. The tool may be adjusted to cut crooked or drip threads, and it will grip any size of coupling for threading short nipples. As all parts are interchangeable, any repair part is guaranteed to fit.

New Company Offers Steel for Residence Construction

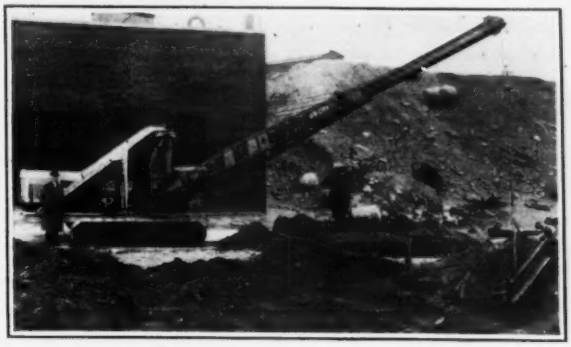
Steel for residence construction composed of standard rolled-steel structural sections has recently been placed on the market by the Steel Frame House Company, Pittsburgh, a subsidiary of McClintic-Marshall Corporation. The structural members are so fabricated that building plans can closely follow the standard forms of construction.

The vertical members are composed of two angles, both legs of which are punched with holes closely and uniformly spaced. The two angles are tied together by means of clips at the top and bottom ends and by intermediate tie plates. This arrangement of the angles leaves a space between, which is utilized for the installation of wind bracing or for running wires for electric lighting conduit systems, etc. The sills, girts and plates consist of two channels, placed back to back with a space between similar to the stud construction. Roof framing utilizes either angles or channels, the connections between the rafters and plates at the eaves and the two rafters at the ridge being made by gusset plates. The interior partition members are studs similar to those used in the exterior walls. A standard set of clips is furnished with the framing, and adherence to the uniform spacing of holes in both the vertical and the horizontal direction of all members provides unusual simplicity for the connections, which are made by bolts.

Standard door and window frames can be used, since the steel studs permit the same thickness of wall as regular 2x4-in. wood studding. Window and door headers, short studs and special details are shop assembled.

Adjustable Backfiller for Tractor Shovel

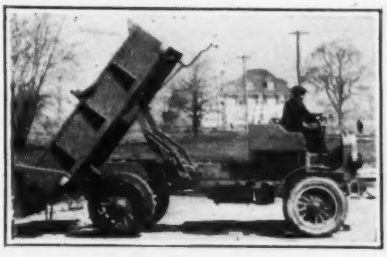
The standard tractor-shovel of the Bay City Dredge Works, Bay City, Mich., has been equipped with a special backfiller boom. The boom itself is 25 ft. long. In addition a 10-ft. telescopic extension is provided. An important feature of the boom is that this telescopic extension is cable-operated and can be run in or out, varying the length of the boom by any amount from



25 to 35 feet. The equipment is shown operating a 48-in. backfiller bucket for B. Picone & Sons, contractors, Brooklyn, N. Y.

New Rotary Dump Hoist Inclines Truck Body to 60 Degrees

A new rotary dump hoist mechanism has recently been perfected by the Autocar Company, Ardmore, Pa., which will raise the truck body to an angle of 60 degrees, as compared with the 40 degree angle which was formerly the maximum. One of the most important features of the new mechanism is an automatic arrangement which cuts off application of the power as the body



reaches the maximum elevation and similarly cuts off the power when the body has returned to full normal position. This requires no attention from the driver, so that he may place the truck in motion before the body has become seated. The new hoist was designed especially for highway use where the increasing haulage of wet concrete has made steep dumping angles desirable.

Some Notes on the Production of Asphaltic Limestone

Development of the Alabama asphaltic limestone deposits which started six years ago at Margerum, Ala., has proved up by means of diamond drills a huge tonnage of bituminous limestone, comparing favorably in quality with the European deposits, according to J. H. Conzelman, of Alabama Rock Asphalt, Inc. Margerum asphaltic limestone pavements laid on numerous Southern city streets and state highways have given uniformly excellent results.

The deposit at Margerum is a limestone impregnated with bitumen. It occurs in a stratum from 7 to 18 ft. thick, covered with 3 to 20 ft. of overburden. The bitumen content varies from 3 to 8 per cent. In preparing it for use the rock is sorted in the quarries and then mixed so that the pulverized asphaltic limestone contains uniformly from 5 to 6 per cent of bitumen. The final pulverized size passes a $\frac{3}{8}$-in. sieve.

Variation in the bitumen content of the asphaltic limestone is not a source of trouble, states Mr. Conzelman, since careful attention is given during production to its control. Samples are taken daily from the working faces of the quarries, and the rock is sorted and mixed in the quarries before going through the various crushing and pulverizing steps. An additional precaution to insure uniformity is the use of a storage bin that holds at least one day's production. The pulverized asphaltic limestone is distributed back and forth over the length of this storage bin by a belt conveyor equipped with a traveling tripper. Tests are made daily on the plant production and each car before it is shipped is sampled and tested. A notice is sent out with each car stating its bitumen content.

The asphaltic limestone may be laid on any type of new foundation that would be satisfactory for sheet asphalt or asphaltic concrete. It is especially adaptable to resurfacing old concrete, stone, block, bituminous macadam, water bound macadam, or gravel surfaces.

Manufacturers and Trade Associations

Calendar

Annual Meetings

AMERICAN WATERWORKS MANUFACTURERS ASSOCIATION, New York City; annual meeting, San Francisco, Calif., June 11-15.

TRACK SUPPLY ASSOCIATION, Chicago; annual exhibition and convention, Detroit, Sept. 18-20, 1928.

New Publications

Induction Motors—ALLIS-CHALMERS MANUFACTURING COMPANY, Milwaukee, Wis., devotes its bulletin 1118-E to its polyphase induction motors, type AR and ARY. These are respectively squirrel-cage and slip-ring general purpose motors. The bulletin describes both the slip and roller-bearing types in both horizontal and vertical designs.

Business Side of Construction

Facts and Events That Affect Cost and Volume

Week's Offerings Third Highest

Bond offerings during the week ended June 8, 1928, totaled $231,180,864, the third highest week in 1928. One issue constituting 30 per cent of the total was a $70,000,000 Tokyo Electric Light first mortgage, the largest foreign corporation issue and the largest power issue ever offered.

Total offerings in May, 1928, were $491,080,000, or $185,000,000 lower than a year ago. March was the only month this year during which the volume of offerings exceeded those in the corresponding month of 1927. In May, 1928, offerings of three classes of bonds, foreign, real estate and miscellaneous, were greater than those last year. Five months this year are here compared with a year ago:

	1928	1927
Railroad	$292,690,000	$364,450,000
Public utility	685,620,000	789,700,000
Industrial	428,490,000	546,180,000
Municipal	337,270,000	486,340,000
Foreign	737,330,000	651,510,000
Real estate	177,950,000	114,320,000
Miscellaneous	69,080,000	101,530,000
Total	$2,728,430,000	$3,054,040,000

Foreign issues have constituted about 27 per cent of the total bond offerings in 1928, public utility 25 per cent and industrials, the third largest group, 16 per cent.

The two weeks ended June 1 and 8 showed total offerings practically the same as a year ago. There were 43 issues in the second week, 17 of which were municipal offerings. The foreign group totaled $110,200,000 and consisted of six issues.

The proceeds from the Frankfort-on-Main issue will be used for improving and enlarging the city's public utility properties from which a large proportion of its gross revenues are obtained. The Georgia & Florida Railroad has asked for authority to issue $1,000,000 bonds to finance the completion of the extension of its lines from Augusta, Ga., to Greenwood, S. C.

IMPORTANT BOND OFFERINGS

	Amount	Interest	Yield
Public Utility:			
Northern Utilities Co.	$3,250,000	6	6.10
United Public Utilities Co.	3,000,000	5½	5.70
Northern Utilities Co.	1,700,000	6½	6.60
Greenwich Water & Gas Co.	750,000	5	5.15
General Tel. Utilities Co.	3,500,000	5	5¼
Indiana Hydro Electric Power Co.	3,000,000	5	5
Northern Electric Co. & Northern Paper Mills	4,000,000	5	5.10
Southern Cities Utilities Co.	3,000,000	6	6
Texas-Louisiana Power Co.	1,700,000	6	6
American States Public Service Co.	1,250,000	5½	5.60
Midcontinental Telephone Co.	1,000,000	5½	5¾
Industrial:			
Susquehanna Silk Mills	8,000,000	5	5¼
Houston Oil Co. of Texas	8,000,000	5½	5.37
Richfield Oil Co. of California	5,000,000	5½	5¾
Kentucky Fuel Gas Corp.	4,000,000	6½	6¾
Strawbridge & Clothier	12,000,000	5	5
Container Corp. of America	6,000,000	5	5.14
Municipal:			
Dallas Joint Stock Land Bank Farm Loan	2,000,000	5	4.65
Chicago Lincoln Park	2,000,000	4	4
Spartanburg Co., S. C.	500,000	4½	4.30
Albany, N. Y.	2,452,500	4	3.85@3.90
Youngstown, Ohio	951,832	4½	4.10
Somerset Co., N. J.	828,000	4½	4
Toledo, Ohio	732,000	4½	4.05
Federal Land Bank	26,000,000	4	3.98
Yonkers, N. Y.	1,475,000	4½	3.95
Lake Champlain Bridge Comm.	1,000,000	4½	4.15
Dallas Co., Tex. Rd. Dist. No. 1	2,700,000	4½	4½@4.30
Cleveland, Ohio	1,250,000	4½	4.05
New Orleans, La.	1,000,000	4½	4.12
Houston, Tex.	2,080,000	4@4½	4.15@4.20
St. Petersburg, Fla.	548,000	5¼	4.90

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended June 14, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

Week Ended	Public	Private	Total
June 14, 1928	**$34,767**	**$13,036**	**$47,803**
June 7, 1928	24,059	40,310	64,369
June 9, 1927	30,198	38,374	68,572
Jan. 1 to date:			
1928	591,768	970,986	1,562,754
1927	522,988	794,228	1,317,216

E. N.-R. Index Numbers

Cost			Volume		
June 1, 1928		**206.15**	**May, 1928**		**290**
May 1, 1928	207.00		April, 1928		316
June 1, 1927	205.55		May, 1927		299
Average, 1927	206.24		Average, 1927		263
Average, 1926	208.03		Average, 1926		228
1913	100.00		1913		100

Street Railways Show Continued Slight Decline

City street railway systems are about holding their own, but interurban and suburban companies are finding it more and more difficult to maintain themselves, according to Edmond J. Murphy, chief statistician of the American Electric Railways Association, in the May issue of *Acra*. The private automobile, says Mr. Murphy, and the intercity motor bus are taking a heavy toll from the traffic of the latter groups. Both the number of passengers carried and the operating expenses show slight decreases in 1927, with practically no change in gross income. Examination of the March, 1928, figures for number of revenue passengers show decreases from March, 1927, in all geographical districts except Canada. With the exception of the Pacific Coast states, however, all of the decreases were less than those reported for January and February.

Building Wage Disputes and Settlements

A number of demands for increased wages in the building trades have arisen in the last month. The general character of these is indicated by several examples. Structural ironworkers in Boston demand an increase of 25c. per hour, to $1.50. Carpenters, electricians and common laborers went on strike in sympathy with the ironworkers. Plasterers in Davenport, Iowa, struck because of objection to being paid by check. Asbestos workers in Seattle demand an advance of $1 per day, to $10.

The building industry in Seattle adopted the five-day week, effective May 19, 1928, to include all the major crafts. The schedule is to be applied to the four warm months of the year for the next three years. Carpenters were the last to obtain the new ruling, which had been under negotiation for months with a strike impending.

Carpenters, structural ironworkers, painters and plumbers in St. Louis were granted the five-day week during the last month. The crafts not yet on the five-day basis are bricklayers, hoisting engineers, steamfitters and common laborers. Carpenters in Syracuse were granted an increase of 5c. per hour (to $1.20) on work for the Board of Education of that city.

Bricklayers in Hamilton, Ont., were awarded an advance of 8c. per hour (to $1.20) effective May 6, 1928.

Building crafts in Atlantic City have signed agreements to continue under the present wage schedule until April 30, 1929. The average rate is $1.50 per hour.

The Chicago Building Construction Employers' Association claims there is no city in the country more free from labor troubles and jurisdictional disputes than Chicago.

Following are wage changes noted in the last month:

	June 1	May 1
Bricklayers:		
Minneapolis	$1.31½	$1.37½
Los Angeles	1.25	1.37½
Structural ironworkers:		
Montreal	0.80@ 1.00	0.80
Common laborers:		
Birmingham	0.25@0.35	0.30 @0.35
Denver	0.50@0.62½	0.31½@0.50
Kansas City, Mo.	0.35@0.75	0.40 @0.75
Minneapolis	0.45@0.60	0.40 @0.60
Montreal	0.30@0.35	0.25 @0.30
St. Louis	0.40@0.75	0.45 @0.75

Cement Shipments High in May

The ratio of the operations to the capacity of the American portland cement industry during the month of May was 86.6 per cent, according to figures released June 11 by the Bureau of Mines of the Department of Commerce. During the month 17,280,000 barrels were produced, 18,986,000 barrels were shipped, and there were in stocks on hand at the end of the month 25,921,000 barrels. Production in May, 1928 was 3.5 per cent more, and shipments about 12.6 per cent more, than in May, 1927. Stocks at the mills were 10.3 per cent higher than a year ago.

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